

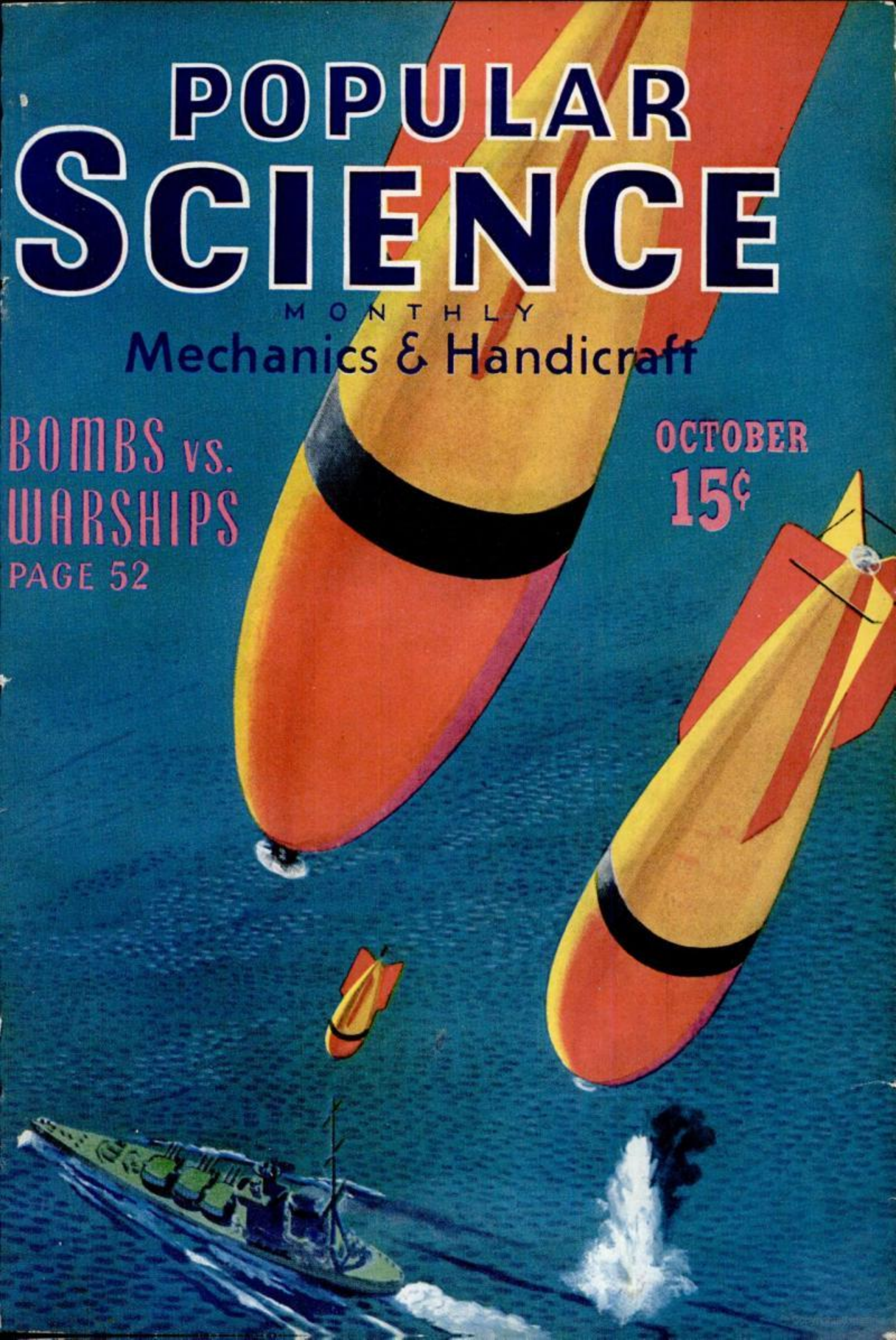
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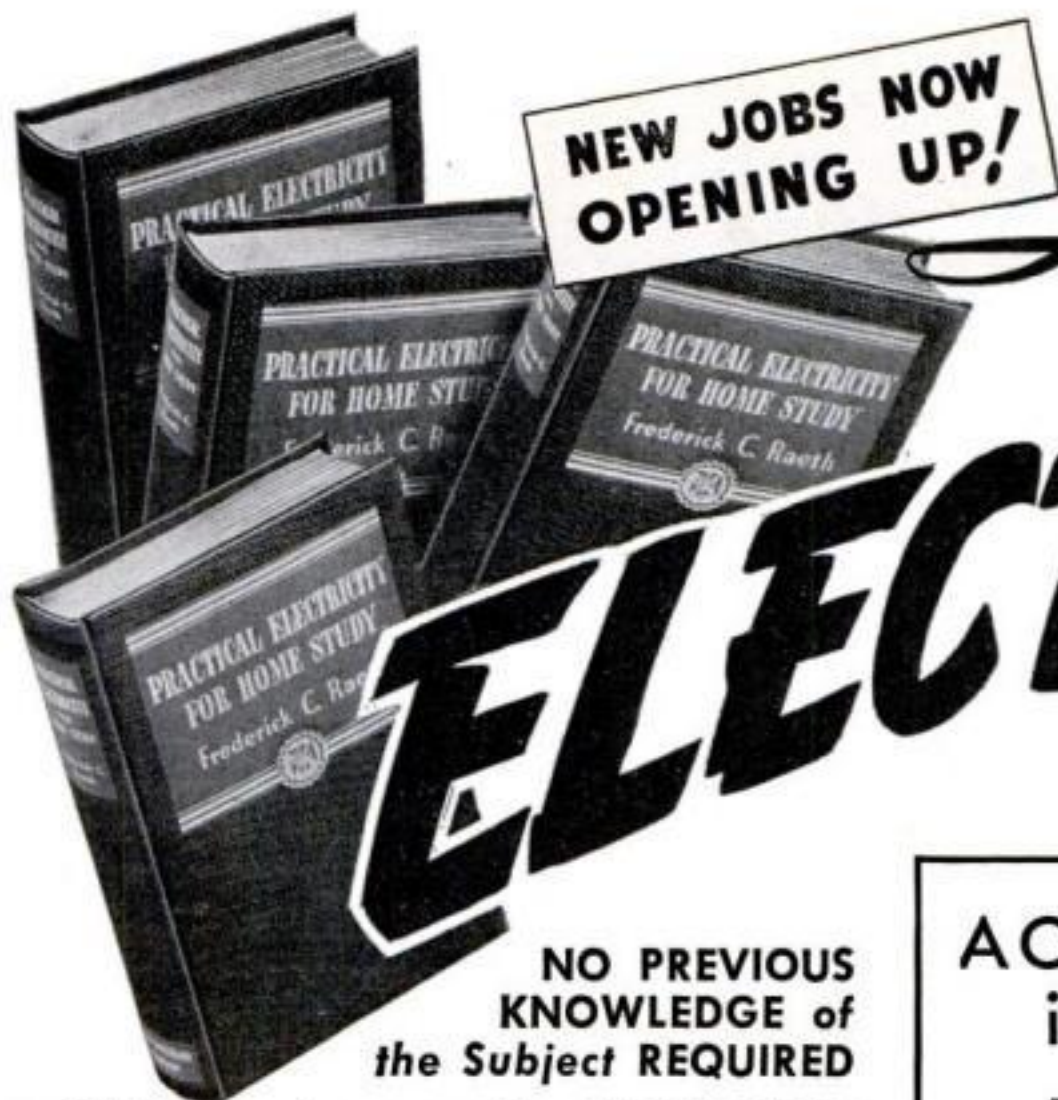
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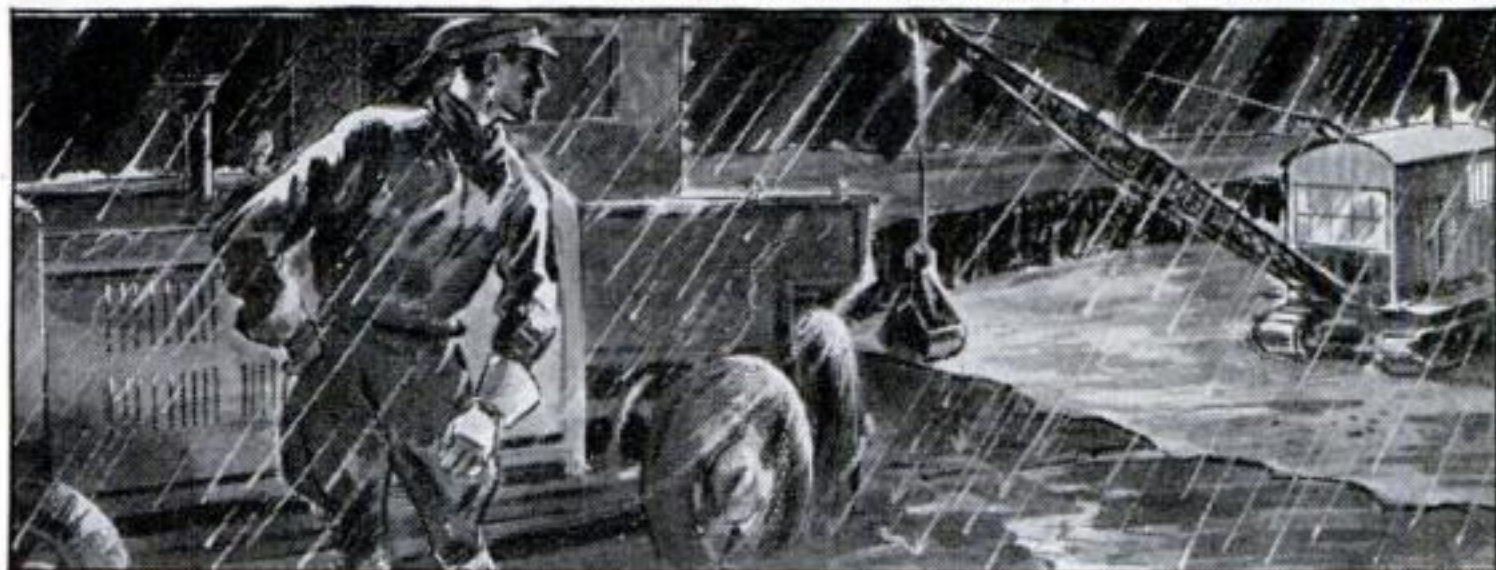
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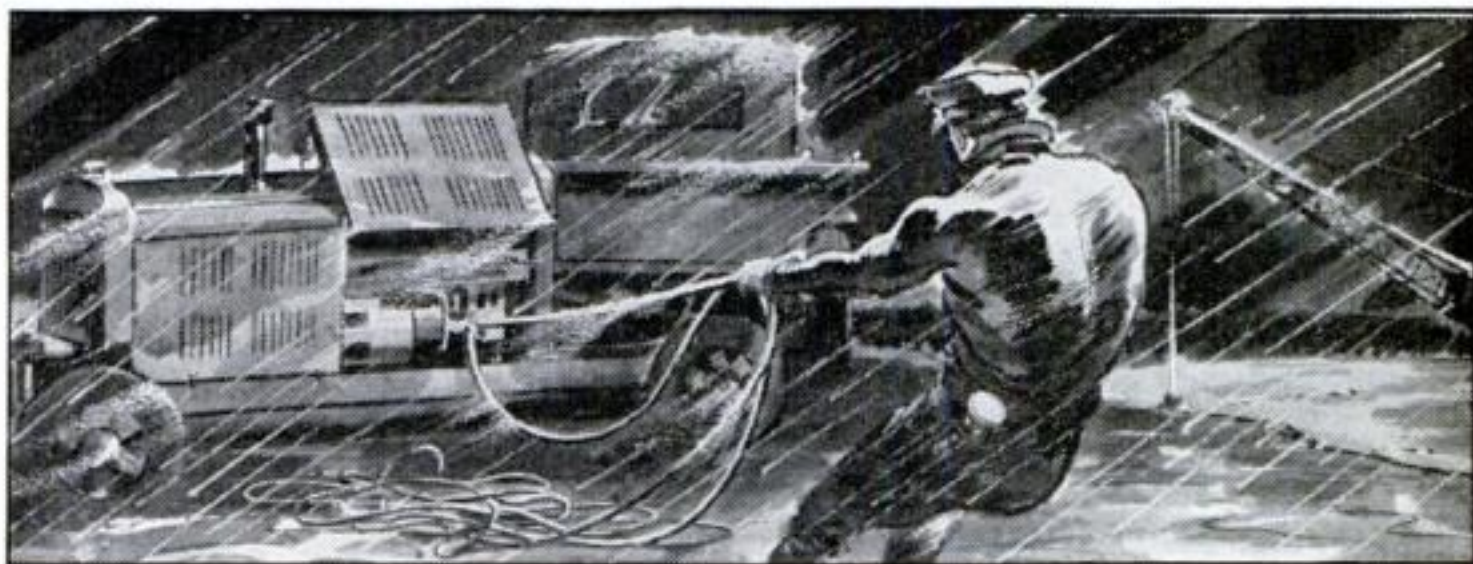
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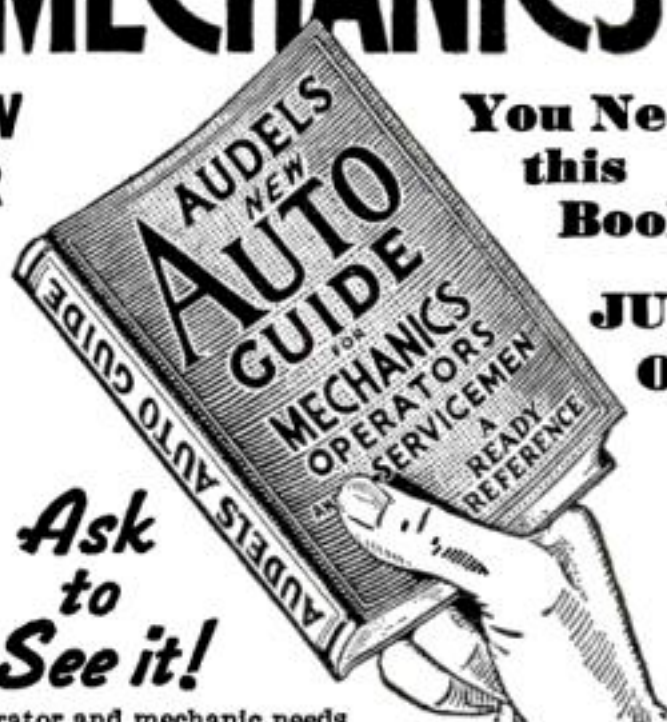
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Operates Public Address System
I have a position with the Los Angeles Civil Service, operating the Public Address System in the City Hall Council. My salary is \$170 a month.—R. H. ROOD, City Hall, Los Angeles, Calif.



Jobs Like These Go To Men Who Know Radio

Radio broadcasting stations employ Radio Technicians as operators, maintenance men and pay well for trained men. Radio manufacturers employ testers, inspectors, servicemen in good pay jobs with opportunities for advancement. Radio jobbers and dealers employ installation and servicemen. Many Radio Technicians open their own Radio sales and repair businesses and make \$30, \$40, \$50 a week. Others hold their regular jobs and make \$5 to \$10 a week fixing Radios in spare time. Automobile, police, aviation, commercial Radio, loudspeaker systems, electronic devices, are newer fields of opportunity for which N. R. I. gives the required knowledge of Radio. And my Course includes Television which promises to open good jobs soon.

Why Many Radio Technicians Make \$30, \$40, \$50 a Week

Radio is already one of the country's large industries even though it is still young and growing. The arrival of Television, the use of Radio principles in industry, Frequency Modulation are but a few of the many recent Radio developments. More than 28,000,000 homes have one or more Radios. There are more Radios than telephones. Every year millions of Radios go out of date and are replaced. Millions more need new tubes, repairs, etc. Over 5,000,000 auto Radios are in use and thousands more are being sold every day. In every branch, Radio offers opportunities for which I give you the required knowledge of Radio at home in your spare time. Yes, the few hundred \$30, \$40, \$50 a week jobs of 20 years ago have grown to thousands.

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The day you enroll, in addition to my regu-

lar Course, I start sending you Extra Money Job Sheets—start showing you how to do actual Radio repair jobs. Throughout your course I send plans and directions which have helped many make \$5 to \$10 a week in spare time while learning. My Course includes Television too.

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Our Readers Say



Don't All Speak at Once— Just Raise Your Hands

WHILE attending a movie about a month ago, I saw something that I would like your mental wizards to explain. It was one of those western films where the stagecoach ran away in the usual manner. While I was sitting there waiting

BEEN DOIN' THAT EVER
SINCE THE
FIRST
MOVIE,
SON!



for the hero to catch the runaway, a strange sight caught my eye: the stagecoach wheels were running backward! Everything in the picture was moving in the right direction except the wheels. I have noticed ever since, in western movies, that these wheels always run

backward. Another queer thing is that when the wagon or stagecoach is stopping, the wheels suddenly reverse and run in the right direction, without any apparent reason. I would like some one to explain this phenomenon. It bothers me every time I go to the movies.—G. B., Riddle, W. Va.

When a Ship Sinks, It's Sunk, Seems To Be the Answer

IN ANSWER to A. G., of New York City, I believe a sinking ship goes straight to the bottom. Its rate of descent would depend upon how it went down—bow first, or otherwise. As to the ship remaining suspended at a certain depth, this is a popular misconception. Its specific gravity would then have to be exactly one. Naval experts have been trying to achieve that in submarines for a long time without success. I doubt if it could ever happen by chance.—C. S., North Tarrytown, N. Y.

ALL GOOD SAILORS
KNOW THEY GO TO
DAVY
JONES'S
LOCKER!



He Likes the New Arrangement of Our Editorial Pages

IT GIVES me great pleasure to commend you on your new editorial arrangement. You also deserve much praise for your constant efforts to improve the magazine and keep it the most valuable magazine on the market, as it has always been in the past.—E. B., Paterson, N. J.

He'd Still Keep the Army Mule for Its Educational Value

THIS plan to mechanize our Army is all right with me, if the generals think it is the thing to do, though we'll surely miss the horses. But what about that educational institution, the army mule? Motor trucks may be able to go faster and haul more, but they can't compete with mules in giving men a fluent command of language. There's something about associating with mules that enlarges the vocabulary; I have heard old-time mule skinner who could teach Noah Webster some words he never got in his book. You can cuss a motor truck too, of course (and some do), but mules seem to bring out everything a man has in him. Mechanize all you want, but keep a few mules to talk to. Otherwise, there will be a great decline in the fine art of name-calling.—M. J., Louisville, Ky.

HOW'S THAT?
GIDDAP YOU

@*?!!!



Putting a Speedometer on the Moving Shadow

THE problem of the rate of the moving shadow in the August issue was excellent for brushing up on college calculus. The shadow was moving at the rate of four and four forty-ninths miles an hour (or approximately 4.082) at the required instant—that is, if my involved calculations are correct.—R. G. A., Brooklyn, N. Y.

Now All We Need Is a Perisphere

WHILE resting my dogs after an all-day tour of the New York World's Fair, I want to write a belated letter of appreciation to the editor of my favorite magazine. Going through the scientific and industrial displays at the exposition grounds, I realized as never before how thoroughly P.S.M. has kept me posted on new developments in all fields of research. There was not an exhibit that I saw today which was not made more interesting and understandable to me by my reading of your pages. I realized that you have been doing in words, photographs, and drawings just what the exhibits do. In short, P.S.M. is a world's fair in itself—and a little

(Continued on page 14)



the Case of the Crying Wife

1 Ann doesn't cry easily—but that night I found her in tears! "I can't help it," she sobbed. "All the things we were going to do—buy a car, build a home—remember? And here we are—married three years, and just barely making ends meet! I thought our dreams might come true—but it's no use." I made up my mind right then to "have it out" with the boss.



2 "Look here!" he said. "I can't *pay* you more unless you're *worth* more! And frankly, John, you lack the *training* a bigger job needs. Ever hear of the International Correspondence Schools?"



3 When I learned the boss was a former I.C.S. student, I signed up *quick*! And what a difference it made in my work! I'd never realized until then how *little* I knew about the business.



4 I'm happy, and Ann's happy, and I guess the boss is happy. (At least I've had two "raises" in the last year!) And here's the very same coupon that I mailed, staring you in the face!

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Our Readers Say (CONTINUED)

easier on the feet. Why don't you call it "A World's Fair in an easy chair"?—T. J. J., White Plains, N. Y.

Doughnut Dunker's Bad Example Proves To Be a Good Problem

THE math-minded boys have been entertaining me for several years through the medium of Our Readers Say, so I shall



reciprocate by giving them a little food for thought: A man was getting ready to dunk a doughnut in his milk. He had a hemispherical bowl of six-inch diameter, containing seven gills of milk, and a nice, fat doughnut of four-inch outside diameter with a one-inch-diameter hole. By accident he dropped

the doughnut, which floated horizontally, half submerged in the milk. How much milk did the dunker have to mop up off the table?—(Miss) H. M. S., Baltimore, Md.

Readers Get Together on Siamese-Twin Bike

IN YOUR August issue you have a picture of a three-wheeled tandem bicycle made by attaching the front fork of one bike to the rear axle of another. This is old stuff. I made one with a friend more than three years ago. It isn't as rosy as you have it, though. In the first place, you have to ruin some one's front fork by enlarging the holes to go over the axle of the other bike, and also it must be spread an unusual amount because of the length of the rear axle. Secondly, you cannot prevent a torque effect in the middle, and the riders must do a hula to keep the bike going. All in all it isn't bad, especially if *your* bike is used for the lead.—H. M., Jamestown, N. Y.

WHY NOT GO BACK TO THE OLD TANDEM BIKE?



WITH my cousin, I have used this method of cycling for some time, and heartily recommend it for long-distance travel. By tuning our bicycles up, we are able to reach speeds approaching fifty miles an hour; a speed of twenty miles an hour can be held for some distance without tiring the riders. There are, however, certain difficulties encountered

(Continued on page 16)

in this arrangement. In starting, until practice has been had, an unpleasant swinging is given to the rear man, sometimes enough to throw him off. On corners the rear man should stop pedaling and give all his attention to balancing. The sharpest turn possible is about a ten-foot circle, and the bicycles will lock in the turn unless the front man has strong wrists and arms. On sharp turns the rear bicycle leans the wrong way. I have been thrown at least twenty times when turning around in the middle of a street. In spite of these difficulties, however, the ease of travel for distances or hill climb amply repays the riders.—W. G., Winnipeg, Canada.

Whatever Became of the Nicaragua Canal?

THAT was an interesting and timely article on "Enlarging the Panama Canal." Certainly our "Big Ditch" needs every possible protection. But why not put through a second canal in Nicaragua? As I remember it, the Nicaragua site was considered long before the U. S. took over the French project at Panama. In 1888, I believe, a survey of the Nicaragua route was made by a party of U. S. Navy engineers under R. E. Peary, later discoverer of the North Pole. Their report was so favorable that the canal was nearly built there in the first place. More recent surveys by Army engineers have confirmed the feasibility of the plan. With two entirely separate canals, it would be some job for an enemy to bottle up our fleet in one ocean. There is another advantage in this plan: with two separate canals, there would be two different sea approaches. That would make it harder for an enemy to cut off our naval and merchant ships by mines or blockade.—E. S. T., Washington, D. C.

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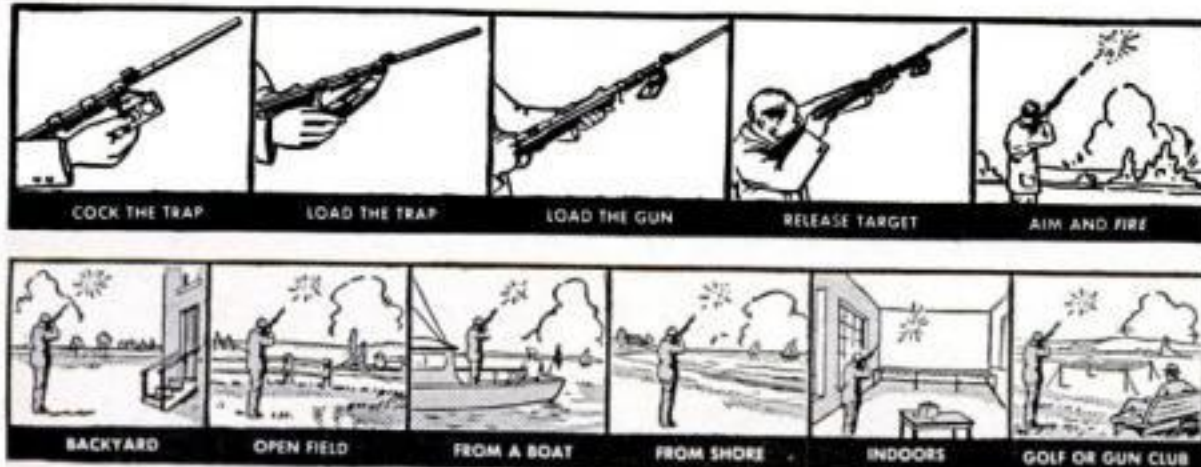
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MY WIFE was stricken with blindness last October and we were compelled to go away for medical treatment. Now we have re-



turned home so she may recuperate and slowly regain her eyesight, happy in knowing that medical science and surgery have saved her from blindness. But we have not missed an issue of POPULAR SCIENCE. You see, women like POPULAR SCIENCE as much as men, so I read each issue to her. The effect on her mental condi-

tion, in aiding recovery of vision, was worth the magazine's weight in gold to us. Which leads me to tell you that your staff little realize, as you send POPULAR SCIENCE on its way throughout the world, the great amount of happiness and contentment it carries into homes. The reading of its pages to my wife brought a change and contentment to her when life seemed darkest and those printed words helped greatly in leading to her recovery. Our doctors, when told of the comfort she received from hearing it read to her, said, "Don't miss an issue. Read it to her. It's as good as our medicine now, because she needs rest and quiet nerves. It will greatly help her on the road to recovery." So I am deeply indebted to you, your staff, and the most welcome magazine.—R. R. R., Bitely, Mich.

Why Not Use a Catalyst as a Diesel Spark Plug?

THIS is a question from a layman who maybe ought to know the answer but doesn't. Why can't designers and manufacturers of Diesel engines take a cue from the acetylene welder who lights his torch with a minute piece of platinum? Is there no way in which a catalyst could be used in the combustion chamber of a Diesel engine? If Diesel-engine fuel is a hydrocarbon and if acetylene is a related substance, what reason is there that a catalyst related to platinum cannot be used in order to make the Diesel engine of lower compression, and therefore lighter, simpler, and cheaper in construction? I would like to see this question answered, but maybe I wouldn't understand it.—J. V. R., Salt Lake City, Utah.

You Can't Blame the Inventors for Human Cussedness

THERE was an ironic note in your "With the Inventors" last month. In the first item, you listed the airplane as one of the great American inventions. Then, just below that, you described a plan to make houses disappear into the earth to escape bombers. What if the Wright Brothers could have foreseen the use that mankind would make of their invention? Although the airplane is the most striking example, almost every invention you can name has been prostituted to the purposes of destruction. An inventor never knows whether he is making life better for humanity, or helping the race kill itself off.—D. M., Boston, Mass.

Does Friction Upset Electrical Balance of Conductors, Too?

ONE of your readers asked why a static electrical charge appeared on glass and other nonconducting materials when rubbed. I wonder if it could not be that such charges also appear on metal but the metal, being a conductor, dissipates them? It seems to me that most any substance is capable of having some of the electrical balance destroyed by friction.—

THAT'S NOT ALL THAT
FRICTION DESTROYS!



R. S., Pasadena, Calif.

It's All Right If You Don't Puncture Your Maps

TAKE a rubber balloon with writing on it, or draw something on a plain one. Blow it up. The writing or the drawing is enlarged. Well, why not make maps, plans, and other things on sheet rubber? The sheets could have corner pieces with holes for thumb tacks. Then all you'd have to do is stretch out the sheets, tack them down, and draw on the surface. Stretched to the same tension, they could be used any time. Take out the tacks, and your plans shrink for easier filing, carrying, and so forth. You can fold them, crumble them in your hand, drop 'em in the lake, but you can't hurt your plans. Will some one let me know if it works? I never tried it.—D. W., Whippany, N. J.

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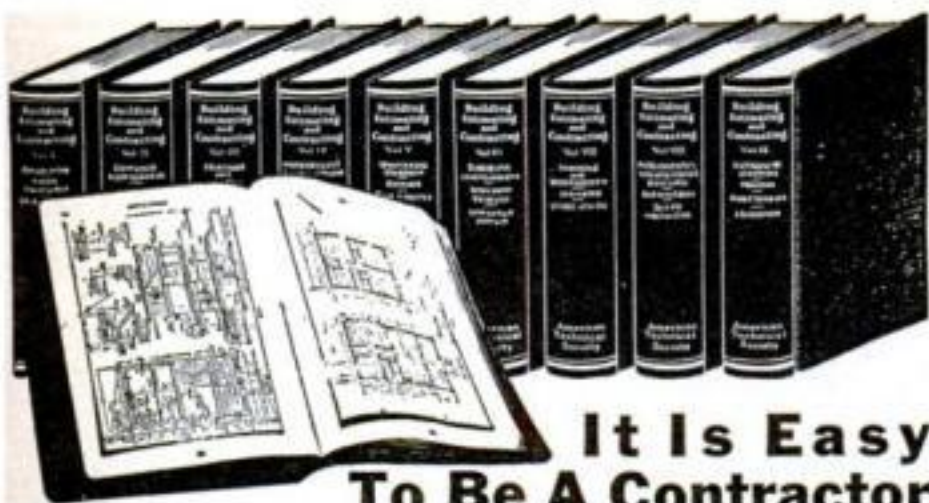
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With the Inventors

WITH Halloween just around the corner an odd false face developed by George L. Edwards, of Fuquay Springs, N. C., should prove of interest to thousands of prospective revelers. Made of thin rubberized material, the comic mask is provided



with air pockets or pouches at the nose, cheeks, and ears, into which air can be blown by an inflating tube held in the mouth of the mask wearer. Thus the ears, nose, or cheeks of the mask can be puffed up into ludicrous forms that change their shape as the mask wearer inflates or deflates the pouches. The false face is attached to the head by means of head straps, and also by loops that are stretched around the ears . . . TWENTY-SIX consecutive patents were recently granted on the same day to one inventor, Sidney Musher, of New York City. Practically all of them relate to methods of stabilizing various foods or food compounds



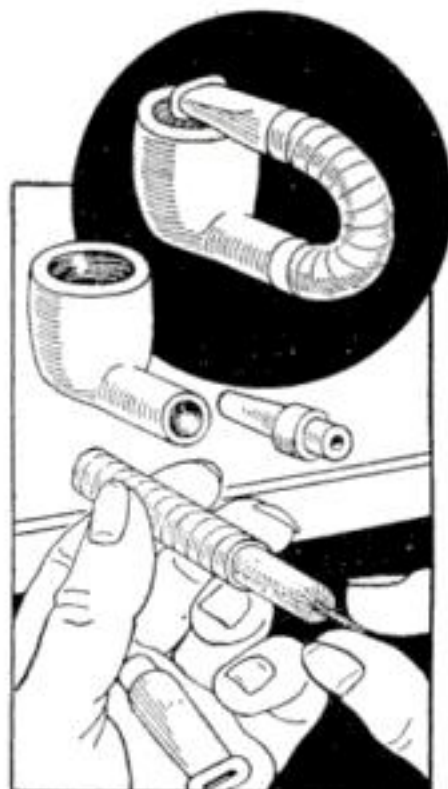
. . . **WALTER KREBS**, of Jamaica, N. Y., is credited with the design of the handy beverage mixer shown in the illustration. powered by two dry cells contained in a flashlight battery case, the unit has mixing blades mounted at the end of a shaft designed to go down into a tall drinking glass. A handle attached

to the battery case of the diminutive mixer makes it easy to hold the unit upright while it is in use . . . CONGRESS has passed and the President has signed a bill authorizing

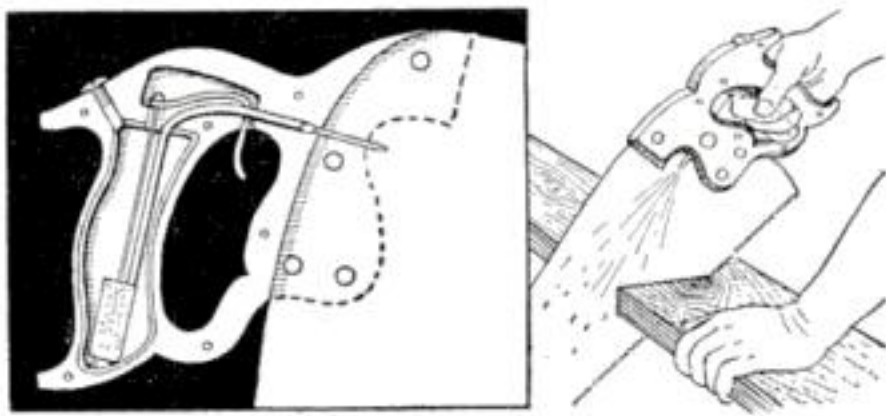
(Continued on page 22)

the Commissioner of Patents to keep secret all patents relating to national defense. The legislation also gives the U. S. Army and Navy immediate access to all war inventions on which patents are now pending or on which patent applications will be made . . .

BECAUSE he recognized that the ordinary smoker's pipe is an awkward object to carry in a pocket, and because he felt that the average smoker likes variety in the shape of his pipes, **Robert S. Blair**, of Stamford, Conn., worked out a novel pipe that has a flexible stem. Made of strips of metal twisted spirally into tubular shape, the stem can be bent back



so that the mouthpiece is over the bowl, thus forming a compact unit that is easy to carry. The stem may also be twisted to any desired shape to give the smoker a straight or curved-stem pipe. Within the stem tubing, a flexible condenser device, consisting of bristles fastened to a twisted wire center, filters the smoke as it passes through . . . **THE FIRST REAL MONEY** that Edison ever made as an inventor came not from any outstanding or basic invention, but from a simple improvement in a telegraphic instrument . . . **OIL IS SPRAYED** onto the blade of a handsaw to lubricate its teeth while in use, by means of a novel device that is the joint



invention of **Albert Pihlquist** and **Arvid Larson**, of East Hempstead, N. Y. From a small oil reservoir built into the wooden saw handle a discharge tube leads to nozzles

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With the Inventors

(Continued from page 20)

located just outside of the handle on either side of the blade. A small pump to force oil onto the blade is operated by a finger trigger located at the top of the hand



hole in the saw handle . . . ANY INTERESTED PERSON may examine most of the material in the U. S. Patent Office, with the exception of correspondence and documents relating to pending patents . . . PAINTERS or artisans at work on elevated scaffoldings are protected against accidental falls by a life - line ratchet invented by Manuel Silvia, of Newark,

N. J. The mechanism, fastened to a belt which the painter buckles securely around his waist, employs a ratchet device that acts on a safety rope suspended from the roof of a building or the top of a scaffold and hanging down behind the painter, out of the way of his work. If he should fall, the sudden downward movement causes the ratchet mechanism to grip the vertical lifeline, effectively breaking if not entirely preventing his fall . . . ELD-ERLY PERSONS, in- valids, and young children should find it much easier to mount or de- scend stairs that are equipped with an auxiliary tread worked out by James R. Boyd, of Whitinsville, Mass. Made of sheet metal the tread is about one - fourth as wide as the regular stair tread, and about one-half as high as the stair riser. Screwed into place next to the stair railing, the auxiliary treads make it neces- sary for a stair climber to raise his feet only one-half the distance of the full riser, as he



(Continued on page 24)

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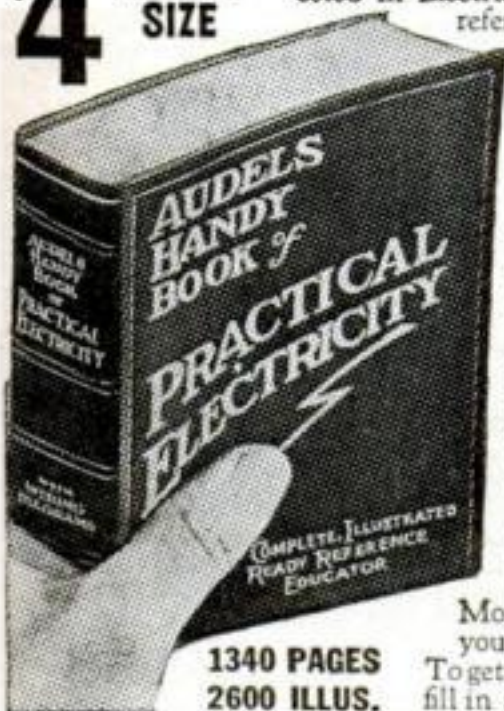
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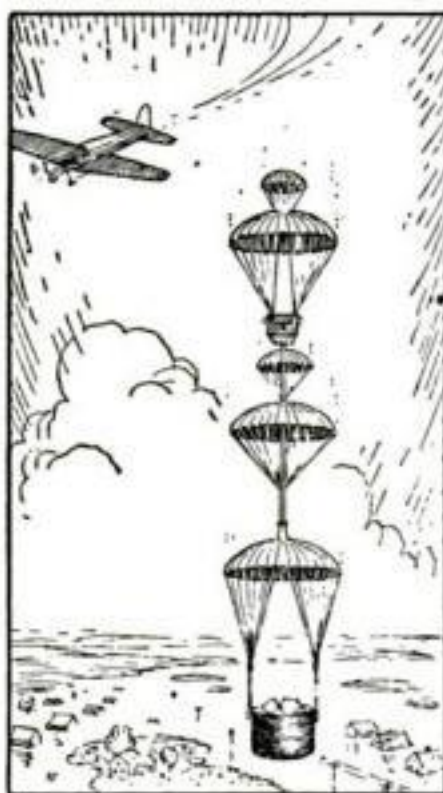
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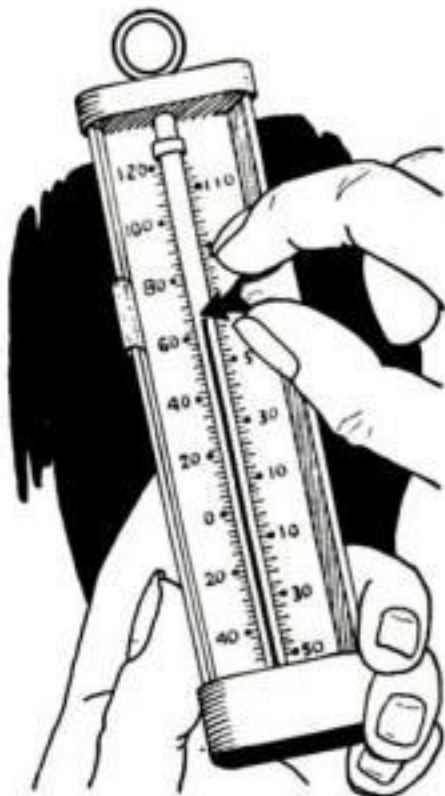
mounts from step to step. As illustrated, one foot will use the regular stair treads and the other the auxiliaries . . . TO MAKE IT POSSIBLE to parachute heavy loads such



as weapons, ammunition, and other military supplies from airplanes to forces on the ground, Francis McCarroll, a Lakehurst, N. J., inventor, suggests tandem parachutes. This arrangement, he claims, would float heavy objects to earth slowly and with little chance of the load oscillating or swinging back and forth as it descends and hits

the ground. In his invention, the load to be dropped would be stowed in a bag or basket attached to a series of three or more main 'chutes, which would open out one after the other from a container in which they are packed. The container would be attached to several pilot chutes, whose chief function would be to open the main load-bearing parachutes . . . FOR NOTING CHANGES in temperature, or as a guide in maintaining a desired amount

of heat or cold in temperature-controlled rooms, a thermometer invented by Stanton L. Lane of Fuquay Springs, N. C., is equipped with a sliding pointer. Set at any level, it shows at a glance whether the temperature is above or below that point. Since the pointer is colored to match the liquid in the thermometer tube, it is easy to read



it at a distance . . . MORE PLANT PATENTS are held by Dr. Ralph H. McKee, of New York City, than by any other individual. His total of patents in this classification is fourteen, all for hybrid poplar trees.



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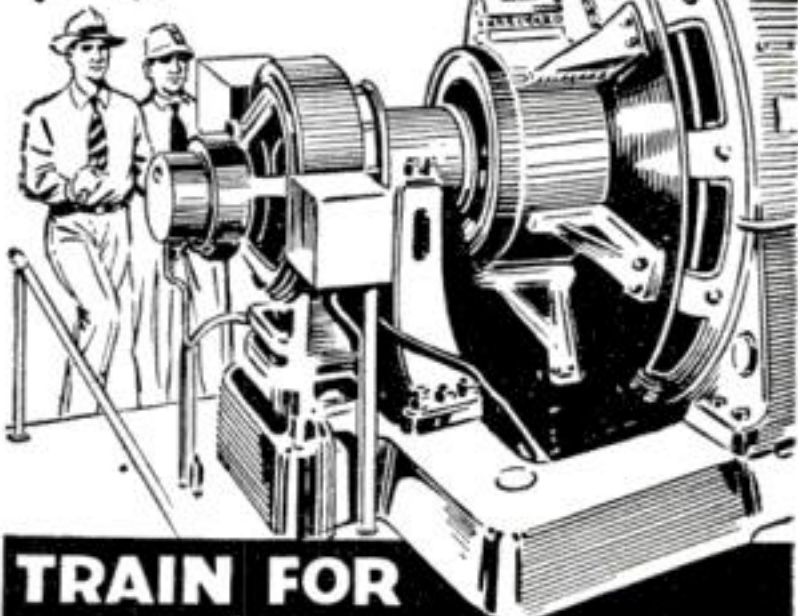
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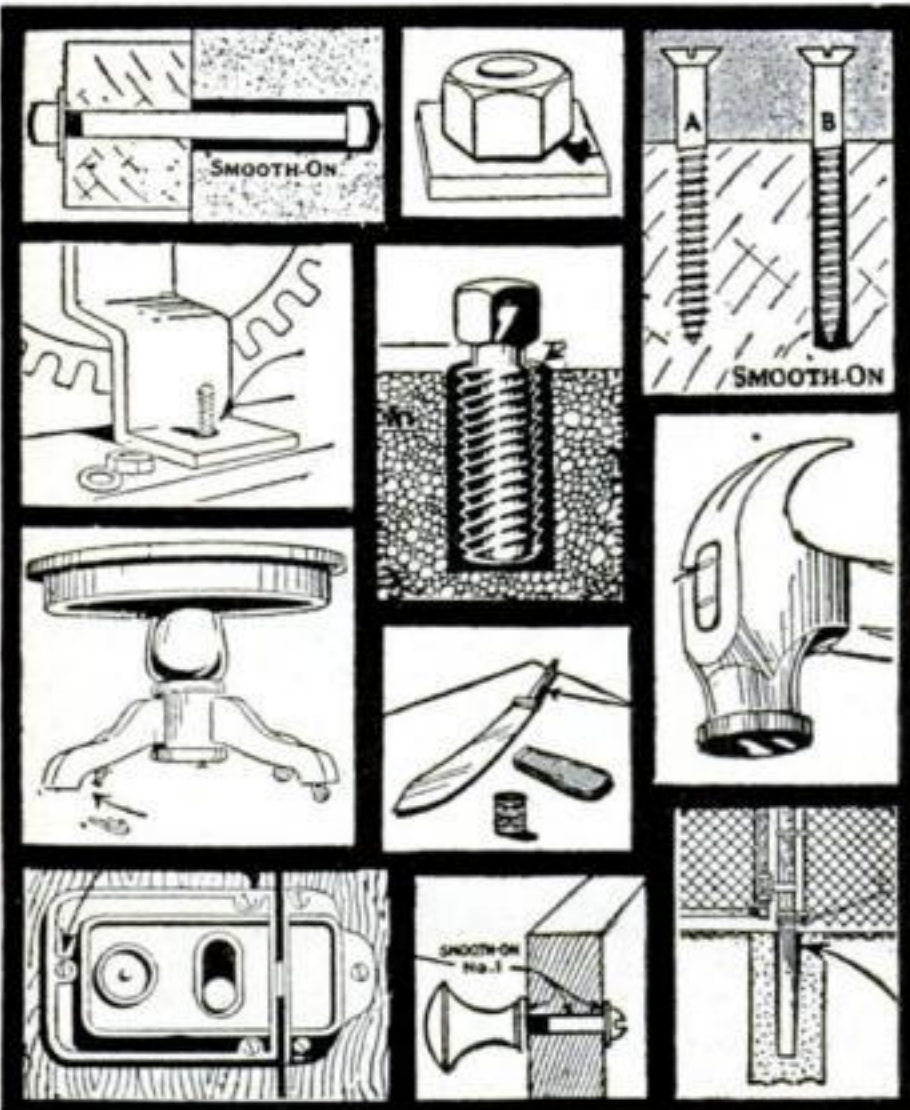


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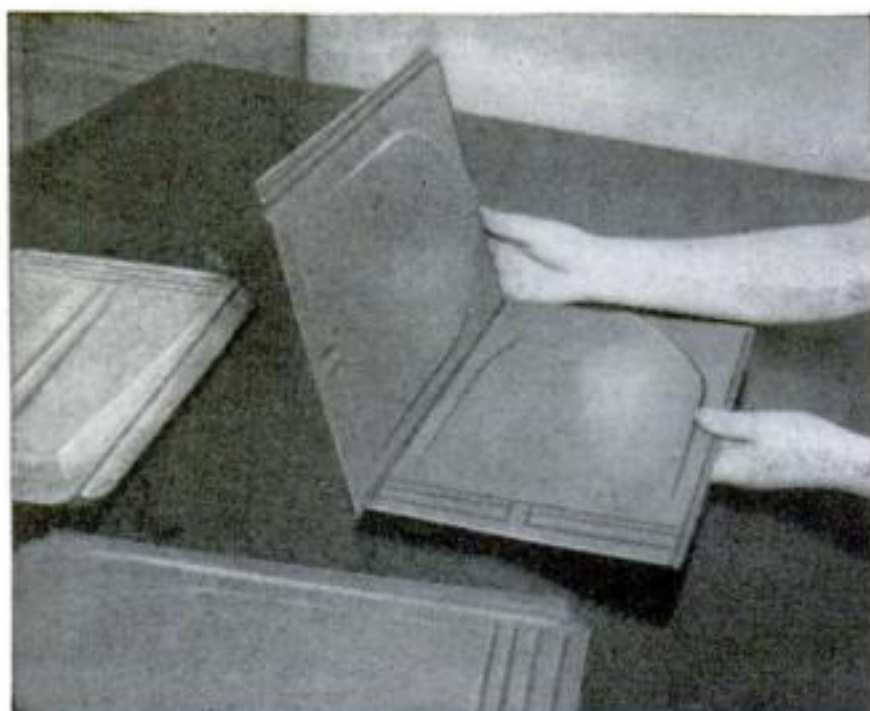


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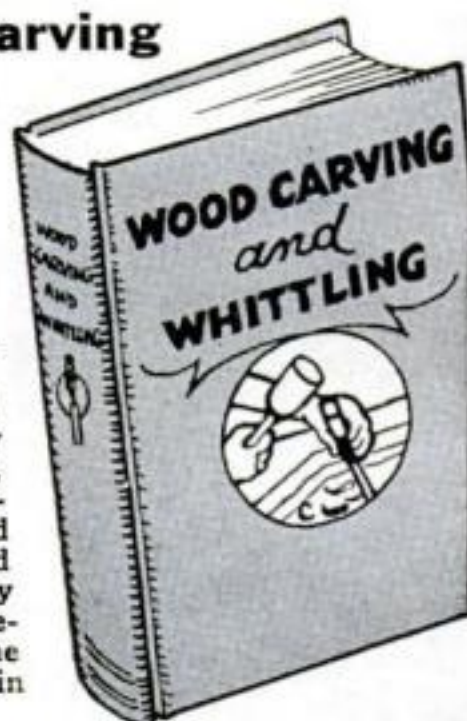


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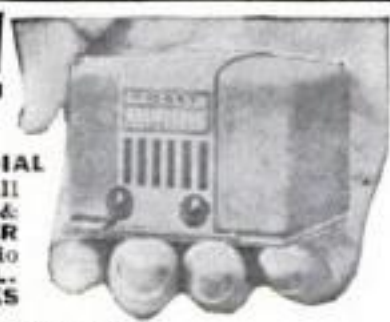
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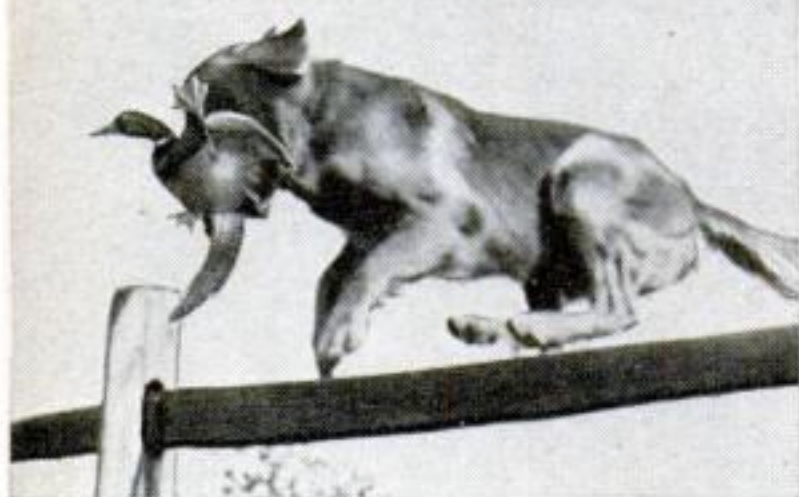
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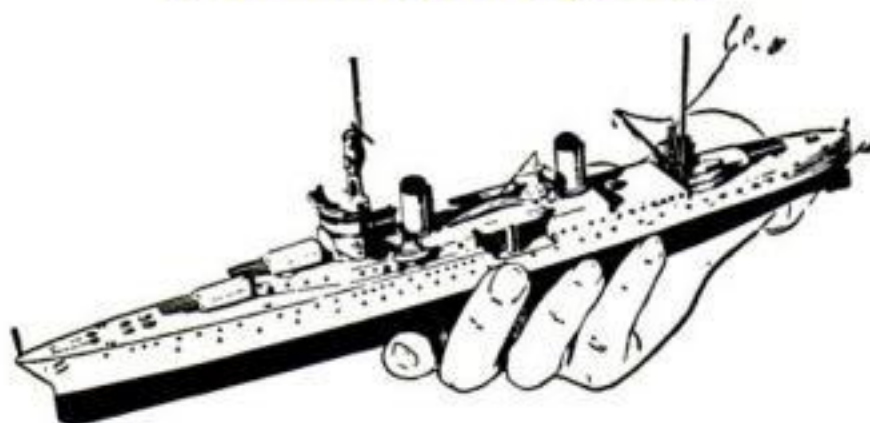
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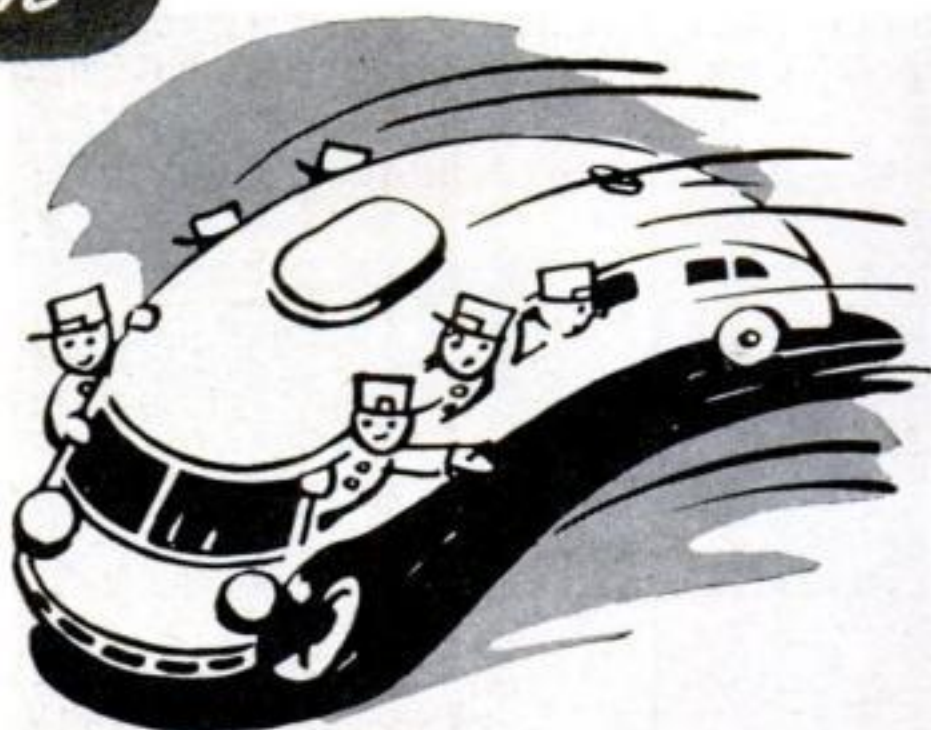
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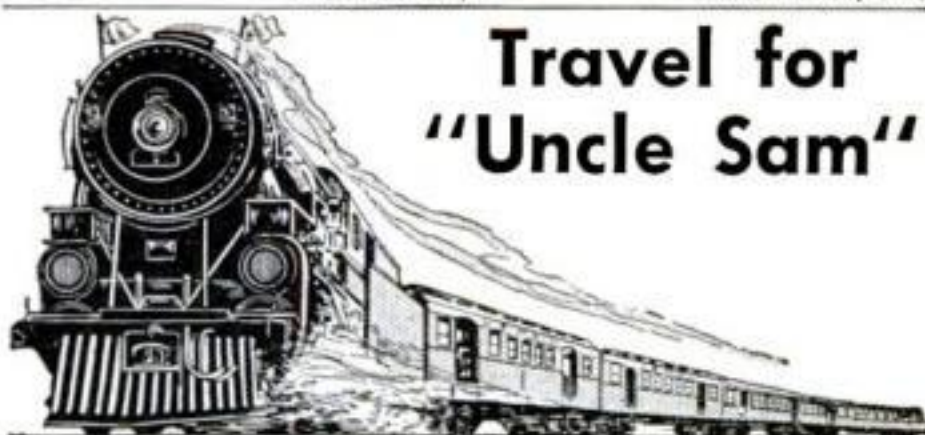
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ADVERTISE: newspapers, magazines, periodicals, lists free. Fidelity Advertisers, 3838-K Washington, Chicago.

26 WORDS, 159 pulling, national magazines \$3.00. Piersimoni's, 1231 Spofford, New York.

40 WORDS, 55 magazines, \$2.00. Bagley System, Box 2522, Portland, Oregon.

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DON'T Be a Job Hunter—Start your own business on our capital. No hard times; no lay-offs; always your own boss. Hundreds average \$3,000 to \$5,000 annual sales year after year. We supply stocks, equipment on credit, 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, dignified, profitable business backed by world-wide industry. Write Rawleigh's, Dept. J-U-PSC, Freeport, Ill.

VALUABLE Gifts—Watches, cameras, etc.—in addition to doubling your money by easy selling of our 64 piece masterpiece box of French-fold Christmas cards and Seals. Cards and seals in attractive colors by a master designer, all 64 pieces cost 25c—sell on sight at 50c. Write for Free sample set, and Gift Plan today. Be first in your community with this quick seller. American Card Co., Box C-82, Lancaster, Pa.

MAKE money selling Calendars. Largest most complete line in field. Widest price range. Newest designs—DeLuxe, hangers, direct on, commercial, thermometer, metal, miniature, Christmas Card Calendars. Big commissions. Four different selling outfits sent Free. Write today. Capitol Calendars, Dept. 610, Gladys at Hamilton, Station D, Chicago.

CALL on friends with sensational lowest-priced Personal Christmas Cards and stationery. Names imprinted. Also big-value 21 card \$1.00 assortment. Profit, 50c. Experience unnecessary. Samples Free. Wallace Brown, 225 Fifth Ave., Dept. S-35, New York.

GUARANTEED rebuilt watches. Lowest wholesale prices. Free Catalog. Kane Watch, 105P Canal St., New York.

READ CAREFULLY

These Classified Advertisements, under more than 110 classifications, contain a gold-mine of interesting, useful information. Among them you'll find many money-saving and money-making opportunities; new products and services. Make it a habit to read this section every month. It pays.

SELL "Personal Initial" Christmas Cards— 21 for \$1. Novel metallic Gold, silver initials included. 100% profit. 50 name-imprinted Christmas cards for \$1. Many other fast-selling assortments. Samples on approval. Artistic, 497 Way, Elmira, New York.

CHRISTMAS Card Leader brings you quick cash profits. Sensational "Beauty Queen" 21-card assortment sells \$1.00. You make 100%. Ten other fast-selling assortments. Personal Christmas Cards, 50 for \$1, up. Samples on approval. Chilton Greetings, 147 Essex, Dept. A-41, Boston, Mass.

MAN and wife to introduce big line coffee, tea, spices, soaps, household necessities, etc. Good profits. Experience unnecessary. Spare time. Assortment of full size products worth \$6.00 supplied Free. Zanol, 2038 Monmouth, Cincinnati, Ohio.

MAKE extra money easy. Show smart Personal Christmas Cards with name, 50 for \$1, up. Outstanding values. Also 21-card assortment, \$1; others. Big profits. Samples Free. Wetmore & Sugden, 749 Monroe, Dept. 116, Rochester, New York.

EXTRA Money Quick! Sell super-value Personal Christmas Cards, 50—with name—\$1. Finest 21-card assortment, \$1. You make 50c. Complete line. Samples on approval. Waltham Art Publishers, 160 N. Washington, Dept. 359, Boston, Mass.

CHRISTMAS Card Salespeople—Best sellers. You make 50c on new 21-folder \$1 assortment. Christmas Cards with name, 50 for \$1. Other big-profit assortments. Experience unnecessary. 50c sample on approval. Schwer, Dept. X-5, Westfield, Mass.

SELL 50 Personal Christmas Cards—\$1.00. Amazing bargain! 50 folders with customer's name imprinted. Sells fast. Pays big profits. Free samples. Also unequalled \$1 Christmas Card Assortments. General Card, 400 S. Peoria St., Dept. P-73, Chicago.

EVERYBODY that paints needs this booklet, "The Method of Softening and Cleaning Hard Dried Up Paint Brushes." Agents and Distributors wanted everywhere. Sample 35c. Harlem Brush Co., 1547 Park Ave., New York City.

\$1 STARTS you in business selling men's ties, boxed novelties, Slyde-On ties. Write today for descriptive wholesale catalog, free sample materials. Philip's Neckwear, 20 West 22nd, Dept. M-28, New York.

CASH for your services. Opportunity, 2714 Westfield, Camden, N. J.

SELL 50 Christmas cards with name for \$1.00! Four complete, sensational lines! 35 sparkling designs! Amazing values! Box assortments too. Big profits. Experience unnecessary. Samples Free. Noel Studios, 9 East 26th, Dept. D-26, New York City.

ONLY two sales per day makes over \$1200.00 monthly profits. Auto tools. Every mechanic a prospect. 95% virgin. \$50.00 sales makes \$36.00 profits. New. Proven. Protected territory to producers. Year around demand. Mesco, Beaver City, Nebr. 100% PROFIT on \$1.00 sales. Demonstrate and sell, Cel-O-Glaze Kleans as it polishes. We will ship Two \$1.00 size for the price of One C.O.D. plus postage—A trial will convince you. Reliable Mfg. Co., 48 Victoria Rd., Hartford, Conn.

BIG money applying initials on automobiles. Easiest thing today. Free samples. Also, sideline salesmen for short order Decalcomania name plates. "Ralco," 1305 Washington, Boston, Mass.

AGENTS: Opportunity make money; book containing 127 successful business plans; home-office; send for free introductory booklet, Elite Co., 214-A Grand St., New York.

GOOD Paying business silvering mirrors, plating autotools, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. G, Decatur, Ill.

BIG money taking orders; shirts, ties, hosiery, underwear, pants, jackets, raincoats, uniforms, etc. Sales equipment Free. Experience unnecessary. Nimrod, 4922-AV Lincoln, Chicago.

WILL you give us 5% first \$600 you make? Afternoons free! Work home! \$1.000 month reported (exceptional—fulltime). Expect surprise! National-3, BX1240, San Bernardino, Calif.

NEW! Sensational! Push-Button controlled gas tank lock. Electric—Operates from dash. Sold on new Graham Car. Distributors, dealers, here is greatest money-maker out. Write Today, Snap-Up, Ashland, Ky.

SELL bankrupt clothing bargains from home, store, auto. Shoes 15c—Men's suits, overcoats, 75c—dresses 10c. Experience unnecessary. Free wholesale Catalog. Superior Jobbing, 1250-EA Jefferson, Chicago.

COIN Checks: Slugs, razor blades, trick playing cards, etc. Rush 10c for sample layout. Low wholesale prices to agents. De Vere Novelty Co., Dept. 37, Dayton, Ohio.

YOUR ad in this Classification will reach productive sales-getters for your products or services. Rates on request. Popular Science Classified, 353 Fourth Ave., N.Y.C.

MEXICAN Curios sell on sight. Large profits. Free particulars. Samples 10c stamps. Marquez-IX, Apartado 1176, Mexico City.

AGENTS—300% Profit selling Gold Leaf letters; stores and offices. Free samples. Metallic Letter Co., 437 North Clark, Chicago.

OPERATE steady business resilvering mirrors, making chipped glass nameplates, signs. Write Sprinkle, Plater, 910, Marion, Indiana.

CHRISTMAS Folders, 25 and 50 for \$1.00 with name. Assortment privileges. Big profit. Hollinshead Company, 1443 South 58th St., Philadelphia.

CHEMICAL Sponge cleans cars like magic. Banishes auto-washing drudgery. New! Hot seller! Samples sent on trial. Write "Inventor," 120 Kristee Bldg., Akron, Ohio. **FREE** water and our concentrates make 68 products. We supply labels, bottles. Enormous profits. Qualco, F-20030 Russell, Detroit.

CHRISTMAS Cards—America's outstanding assortments. Big profits. Write for samples. Robinson Cards, Dept. 628, Clinton, Mass.

500% PROFIT. Gold and Silver colored sign letters. Offices—stores. Large sizes 1c. Free samples. Modernistic, T-3000 Lincoln Ave., Chicago.

AMAZING new zipper clothesline. Zip garments on or off. Instant demonstration, sure sale every home. Dunn Mfg., Hempstead, N. Y.

SELL Auto Finance Course. Unusual opportunity. Nebraska Finance Co., Lincoln, Nebraska.

ENGRAVED name plates, number plates, signs, profits large. Brett Bros., Elmwood Ave., Winthrop, Mass.

WINDOW sign letters. Penny each. Large sizes. New styles. Absolutely beautiful. Free samples. Atlas, 7941-R Halsted, Chicago.

FREE sample—amazing cleaner: sells homes, taverns, everywhere. Big profit—fast repeater. Besco, 5009-X, Irving Park, Chicago.

EASY money selling graduation cards. 35% commission. Samples free. Printery, A-1407 Howard, Pittsburgh, Penna.

CHRISTMAS Cards. Sell 50 Assorted folders, name imprinted \$1.00—Cost you 50c. Samples free. Dunbar, New Brunswick, N. J.

ANTIQUES, RELICS INDIAN GOODS

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SWORDS, Rapiers, Daggers, Pistols. Catalog 10c. Robert Abels, 860½ Lexington Avenue, New York.

5 MEXICAN arrowheads. \$1.00. Gibbons, 501 Bloomfield Ave., Montclair, N. J.

AUTHORS' SERVICE

SHORT Stories revised, typewritten, marketed. Hursh, Box S-1013, Harrisburg, Penna.

STORIES, novels revised and typewritten for marketing. Welton Tenney, Winnsboro, Texas.

AUTOMOBILES

ILLUSTRATED Fifth edition Automobile Racing Book. Tells how to build dirt track bodies, frames, engines. Records, superchargers, rules, formula, plans, stock conversions, roadster racing, fast Fords. \$1.00 postpaid; \$1.15 C.O.D. Ray Kuns, Department 249, Madisonville, Cincinnati, Ohio.

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SPECIALIZE in Auto-Radio Suppression work. Write Jenkins, 392, Elmira, N. Y.

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PROPELLERS—All types. World's largest propeller catalog 10c. Banks Propellers, Love Field, Dallas, Texas.

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LEARN to fly free. Folder, dime. Ohmeyer, Box 391B, Hempstead, N. Y.

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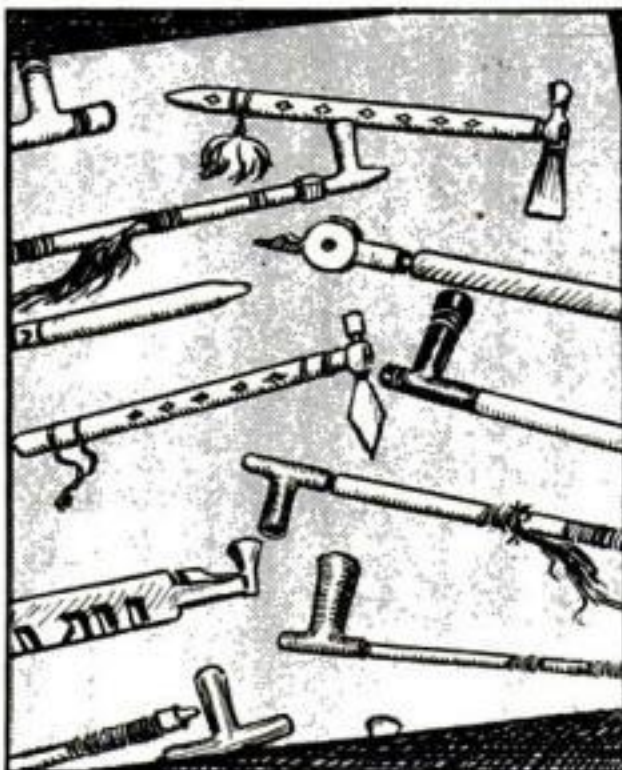
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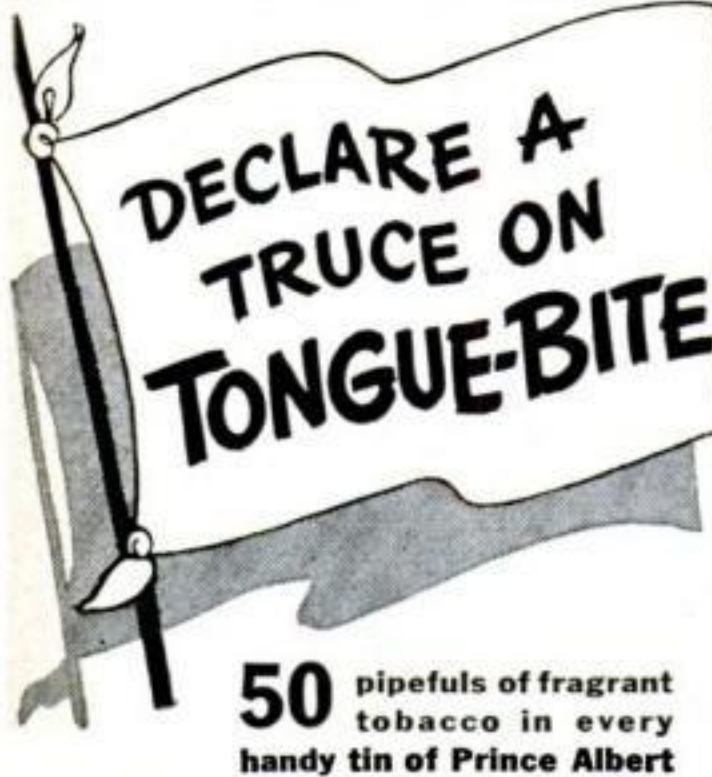
AND A TASTY ONE, TOO. P.A.'S GOT PLENTY OF THE GOODNESS—THE RICH TASTE OF CHOICE TOBACCO WITHOUT HARSHNESS!



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THE NATIONAL JOY SMOKE

ROLLING'S A SIGHT **FASTER** WITH PRINCE ALBERT, TOO. **NEATEST, FIRMEST** 'MAKIN'S' SMOKES BY A LONG SHOT

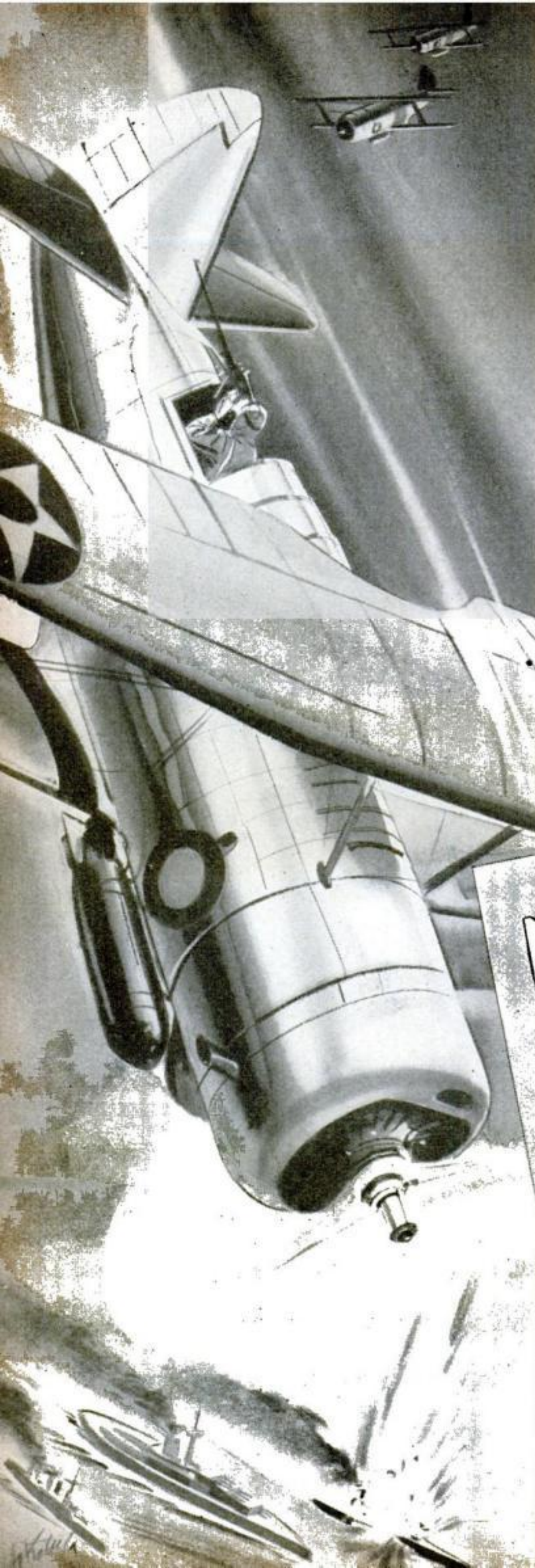


POPULAR SCIENCE *Monthly*

NEW "EARS" LISTEN FOR ENEMY PLANES

A new-type sound detector for locating approaching aircraft, being tested by the U.S. Army at recent maneuvers. Like other devices of its kind, it picks up faint vibrations from plane motors and propellers and finds the direction from which they come, to aid antiaircraft gunners. Other new developments in national defense are shown on the ten following pages





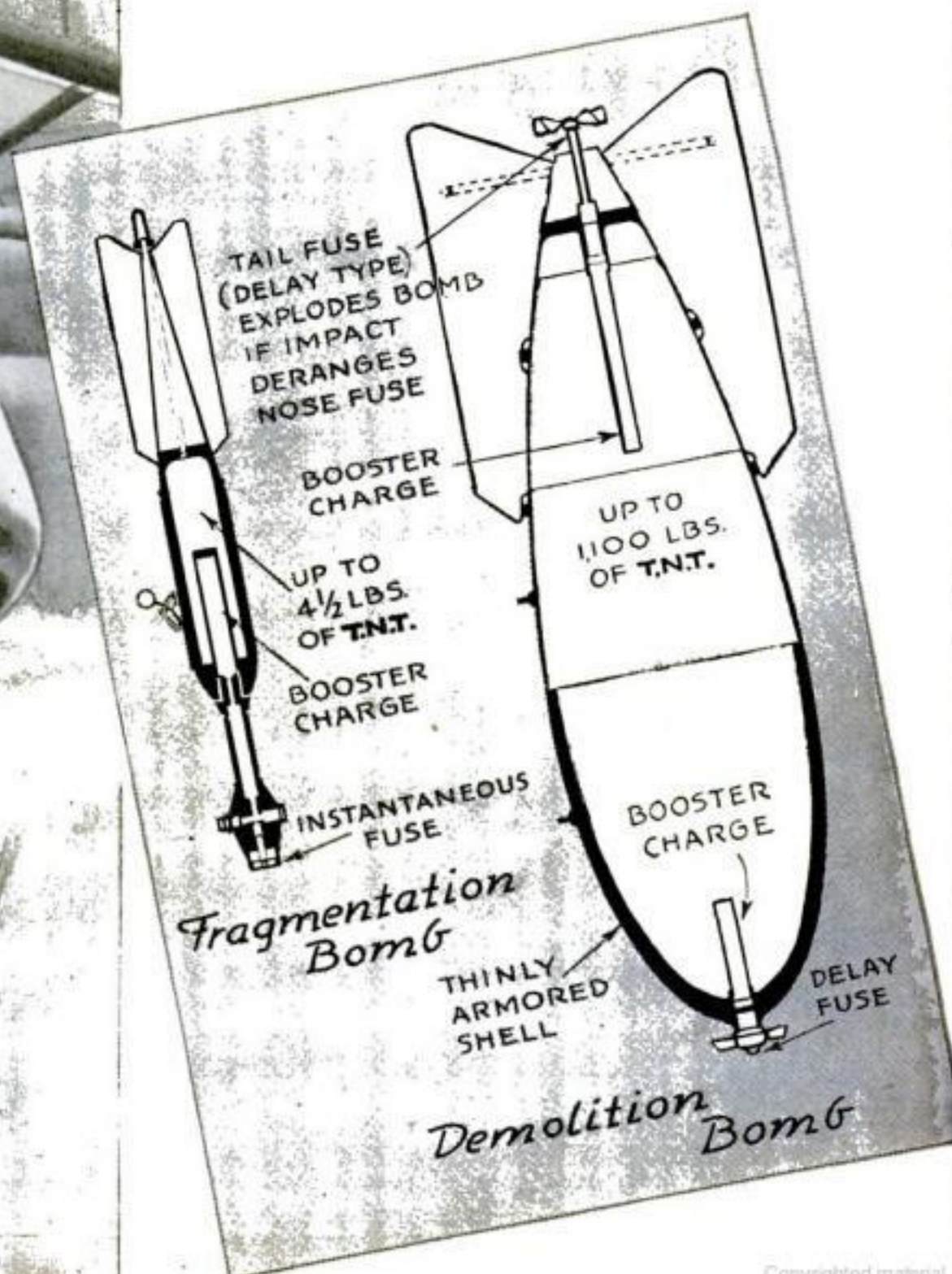
Bombers

HOW NAVAL EXPERTS

WITH waves of swift bombing planes casting their winged shadows over seas long ruled by battleships, modern air power is offering a new threat to naval supremacy. Meanwhile we find ourselves embarked on an unprecedented program of warcraft construction, and the question of how effectively our latest ships can meet this menace from the skies renews a long-standing controversy between advocates of air forces and sea forces.

Here is a composite answer as given by Admiral Harold R. Stark, Chief of Naval Operations; Rear Admiral A. B. Cook, head of the Navy's Bureau of Aeronautics; and other top-flight Army and Navy officers who ought to know, if anyone does, just what planes and ships can do to each other:

Three types of aircraft menace war-



or Battleships?

ANSWER A VITAL QUESTION ON DEFENSE

ships, each in a specialized way—horizontal bombers, dive bombers, and torpedo planes. And each has its advantages and drawbacks.

Horizontal bombers attack their targets from relatively high altitudes, aiming their missiles with a precision bomb sight. The size of these large multiple-engine craft gives them great cruising radius and bomb-carrying capacity. Flying miles high makes them comparatively safe from a warship's anti-aircraft fire.

But all is not on the side of the bomber's crew, by any means. For safety in altitude, they pay in loss of bombing accuracy. Viewed from 5,000 or 10,000 feet, even the biggest warship makes a pretty small gray speck upon the blue ocean. If they descend to improve their chances of hitting it, their own chances of getting hit by its five-inch anti-aircraft guns rise in exactly the same proportion.

And here is a little-known fact. More than half the time, clouds over the ocean prohibit bombing from above 10,000 feet. For days on end, unfavorable weather may keep the "ceiling" much lower.

Even worse, a horizontal bomber suffers from one incurable weakness, owing to its method of bomb sighting. Just before dropping a bomb, for a period variously estimated from fifteen seconds to more than a minute, it must maintain an abso-

lutely fixed course and speed. This delights anti-aircraft gunners.

Dive bombers use entirely different tactics. Power-diving almost vertically upon their target at more than 400 miles an hour, they release bombs at such low altitudes that the projectiles can scarcely miss. In this type of bombing, there need be no elaborate corrections for altitude, wind, and the speed and direction of the target. Only the simplest sort of sight need be used; the pilot virtually aims the bomb by aiming the plane. A favorite stratagem is to "dive out of the sun," so that its glare blinds gunners below.

But the dive bombers' very style of attack means flying down the barrels of all the anti-aircraft ordnance that can be trained upon them. They run the gantlet, not only of the big hand-loaded guns, but also of the shorter-range multiple pom-poms or "machine cannon" that throw a continuous hail of small explosive shells, much as a machine gun fires bullets. Then,

By
**ALDEN P.
ARMAGNAC**

Drawing shows the two principal types of bombs used against warships: Fragmentation bomb (at left) shatters into pieces that wreak havoc among exposed personnel; demolition bomb is designed for structural damage to ship. In photo at right, a low-flying plane drops a torpedo



CLOUDS AT 5000 TO 10000 FT.
OVER OCEAN PERMIT THIS TYPE
OF HIGH-ALTITUDE BOMBING
MUCH LESS THAN HALF THE TIME

LEVEL BOMBING

↑
PLANE MUST FLY LEVEL, STRAIGHT
COURSE JUST BEFORE RELEASING
BOMB, MAKING IT A GOOD TARGET
FROM BELOW....

DIVE BOMBING

TORPEDO-PLANE ATTACK

too, the terrific strain of pulling the planes out of their fast dives requires bombers of this type to be small machines. Because of their diminutive size, their capacity to carry bombs is limited. Likewise, their curtailed weight of fuel tethers them within a short range of their base. An admiral who gives a respectfully wide berth to a "bee-hive" of shore-based dive bombers need have little fear for his ships.

There remains the torpedo plane. To launch the torpedo slung beneath its fuselage, it

THREE WAYS in which planes can attack a warship: At top, horizontal bombing; at center, dive bombing; at bottom, attack by a torpedo plane

WHAT THE BOMBS DO
Effects of direct hit and near miss by a fragmentation bomb (at top, right) and a demolition bomb. Below is a proposed design for a battleship in which turtleback armor protects vulnerable superstructure

DIRECT
HIT

FRAGMENTATION
BOMBS

FLYING
SPLINTERS
RAKE
DECKS

"NEAR
MISS"

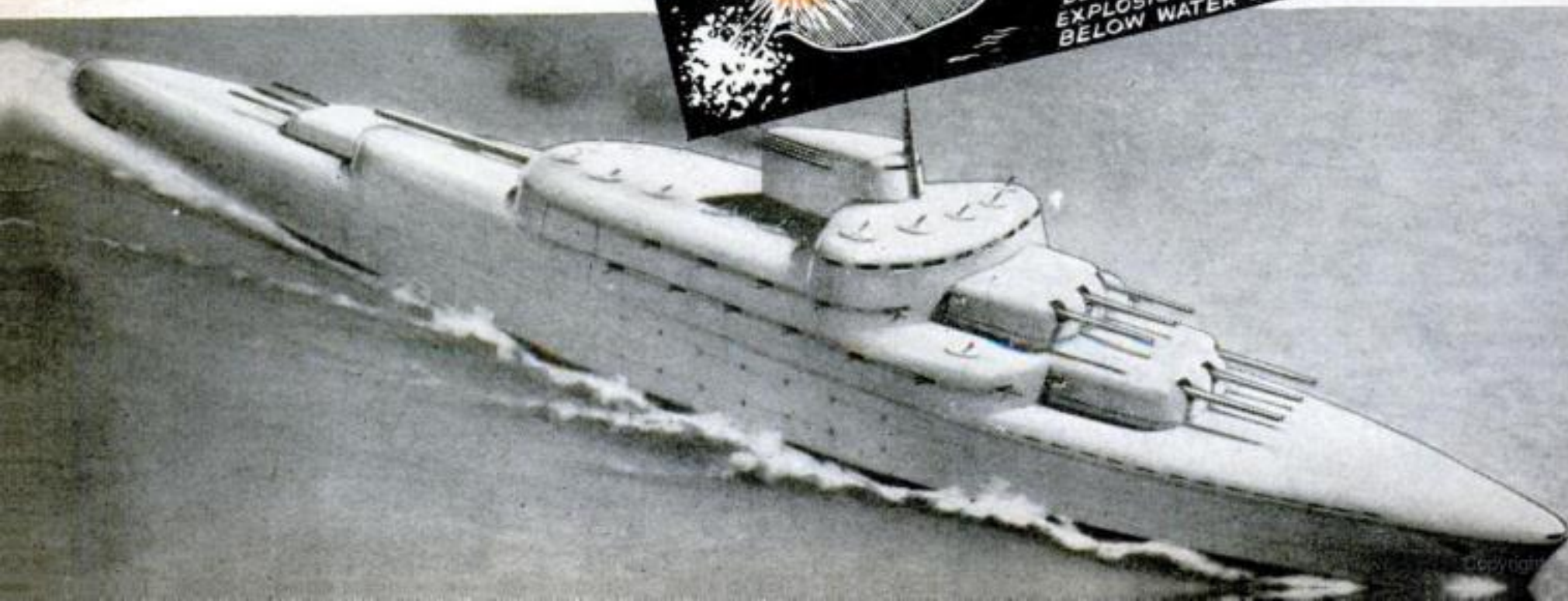
DEMOLITION
BOMBS

DIRECT
HIT
SHIP
LIGHTLY
ARMORED

DELAYED
EXPLOSION
WITHIN
SHIP

"NEAR
MISS"
SHIP
LIGHTLY
ARMORED

DELAYED
EXPLOSION
BELOW
WATER





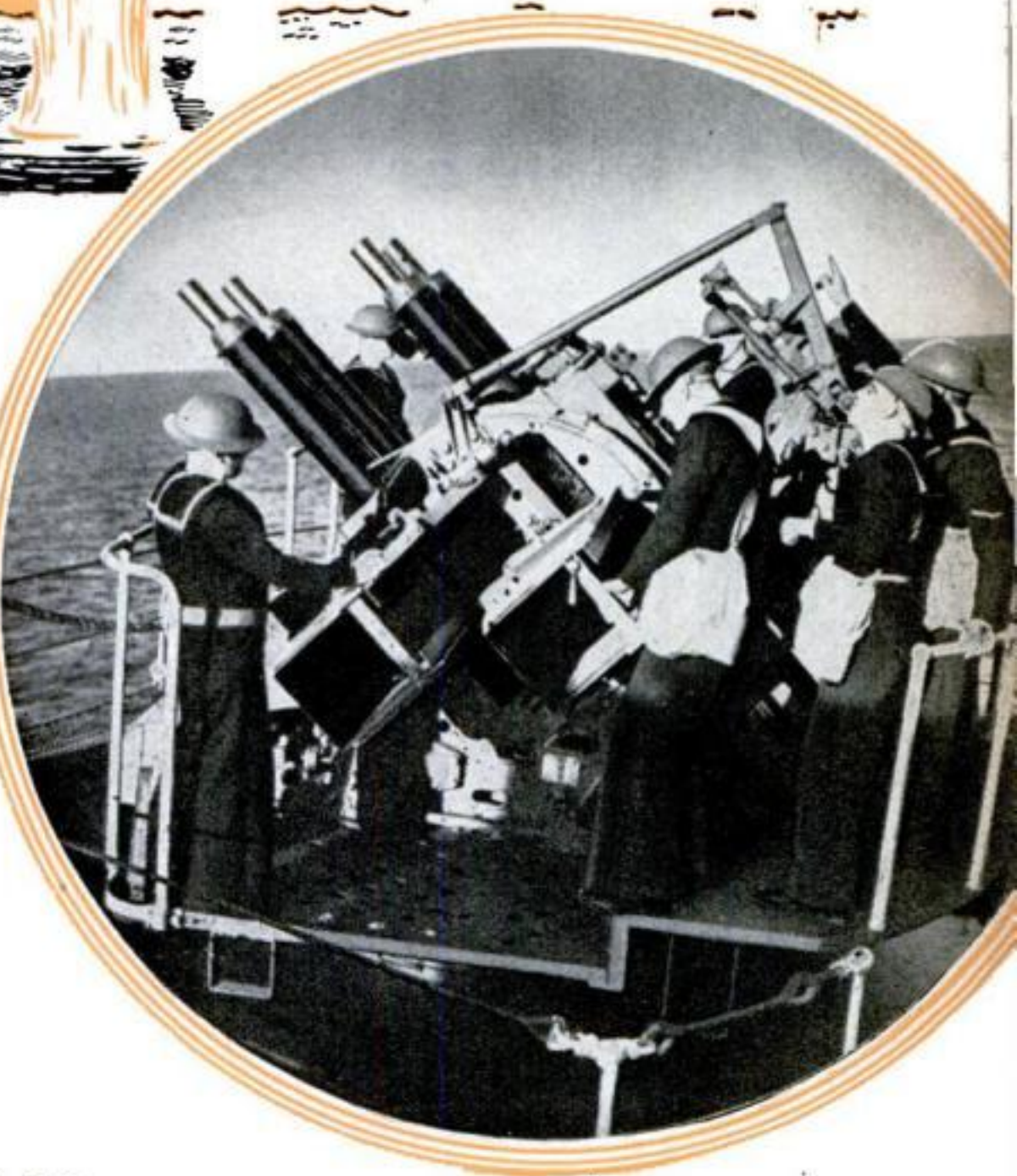
heads toward the broadside of the vessel, skimming close to the water. A likely hit requires a dangerously close approach, under heavy fire from the ship. Shells striking the sea ahead of the plane throw up great geysers of water, which will shear off the wings of an air raider plowing into them at high speed.

Aircraft carriers of a fleet give it additional and powerful protection against all forms of air attack. Fighter planes sent aloft by the hundred from carriers may be able to destroy or ward off the raiders before they reach bombing positions.

But what happens if a warship does have the bad luck to get hit with an air bomb? Whether minor damage results, or Davy Jones's locker receives a new-comer, depends both upon the type of bomb used, and the class of ship.

"Fragmentation" bombs inflict casualties among exposed personnel. Fused to explode instantaneously, they hurl deadly fragments of steel in all directions. If they miss a ship and hit the water near-by, they still detonate in time to rake the deck with their splinters. Because of their light weight—thirty pounds or less—airplanes can carry large quantities of them. For the same reason, they effect little or no structural damage upon a ship.

"Demolition" bombs, on the contrary, are all that the name implies. They range in weight from fifty to 2,000 pounds. Often they are fitted with delay-action fuses, so that they burst after penetrating the target or the surface of the water. So adapted, a bomb of this type acts in the same way as a depth charge to destroy a thin-skinned submarine. Spotted from the air while it

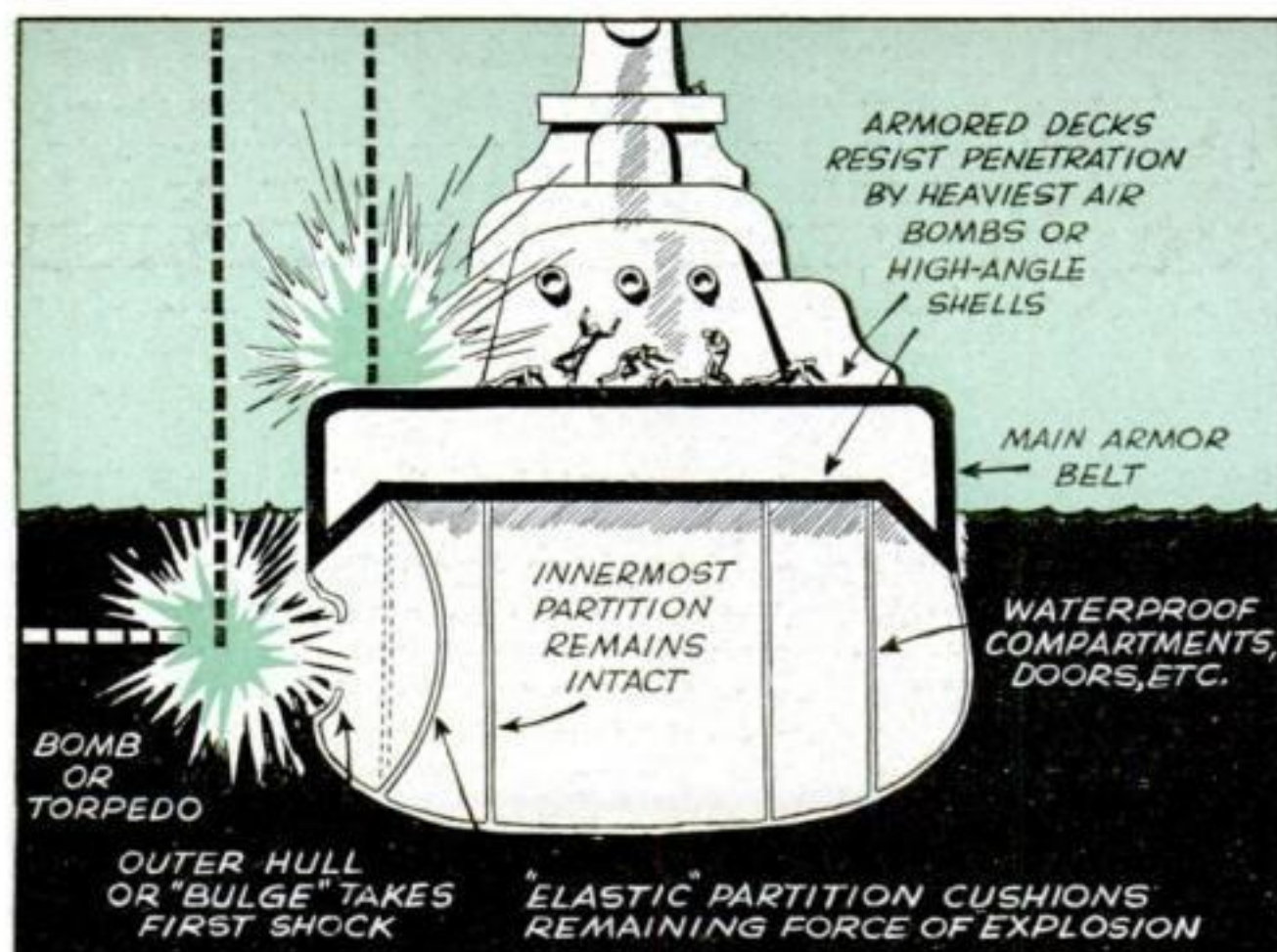


A multiple pom-pom in action. Above, geysers of water from shellfire wreck a torpedo plane

is submerged, an undersea craft is helpless to fire back or, because of its limited speed, to maneuver to dodge bombs. At the surface, it is almost as vulnerable. In fact, reports indicate that air bombers are almost as effective antisubmarine weapons as the sub chasers of the last war.

Destroyers and other small warcraft, too, can be sent to the bottom by a direct hit from a heavy demolition bomb. Their protection lies in their limited size as targets, and their ability to throw off a bomber's aim by fast, zigzag maneuvering.

Bigger ships, though better targets, have more in their favor. Even an amateur mathematician will realize that, when you add



Massive deck and side armor guards the battleship's vital parts from harm

to a ship's size, the deck area increases only as the square while the displacement—and therefore the weight of armor that can be carried—increases as the cube. This explains why great battleships can be armored far more effectively than smaller craft against air bombs.

Massive horizontal decks of armor plate, placed as near as possible to the water line to conserve stability, supplement the "belt" or side armor of modern capital ships. Originally intended to protect the magazine and other vital parts deep in the hull from high-angle shellfire, this deck armor now serves the added purpose of warding off air bombs. In the newly launched 35,000-ton U. S. battleships *Washington* and *North Carolina*, it is reported to attain the extraordinary total thickness of ten inches. Even a 2,000-pound demolition bomb, formidable as it sounds, shatters against such armor like an egg dropped on a concrete pavement.

Special demolition bombs could be built that would penetrate deck armor, but their tremendous weight of steel would allow only a small explosive charge. For gravity to give the bombs sufficient velocity to pierce the armor, planes would have to loose them from an altitude corresponding to the 10,000-foot-high trajectory of shells fired from guns, reducing the chances of a direct hit. And nothing else would do, for an armor-piercing bomb dropping in the water near a ship would carry too little explosive to harm it.

In contrast, a standard thin-skinned demolition bomb acts like a mine if it explodes under water alongside a vessel. Multiple, water-tight compartments are the battle-

ship's defense against such a "near miss," and a damage-control crew springs into action to stop leaks, pump out flooded compartments, and restore the ship to an even keel.

How to protect a big ship's superstructure against direct hits by demolition bombs, which may cripple if not sink it, remains a major problem confronting the world's admiralities. One solution proposed by naval architects envisions warships of the future completely covered with turtleback armor, with virtually all the upper works removed, and only the muzzles of big guns

protruding from the carapace of steel! Whatever form it may eventually take, however, the majestic battleship remains the most invulnerable of all surface craft—as has been proved in actual bombing experiments upon old, scrapped, and radio-controlled U. S. capital ships. One had to be sent to the bottom by shellfire after repeated bomb explosions failed to sink it.

And now, how do all the factors of air power versus sea power add up? Evidently the balance is close—unless the scales are tipped violently, one way or the other, by the particular mission of the sea or air forces.

If shore-based bombers embark on a long-distance raid against an enemy fleet, fuel load will limit their bomb capacity. Lack of escort planes, incapable of flying so far, will leave them open to attack by defending planes, as well as by antiaircraft fire. Loss of valuable bombers is likely to outweigh the military value of any damage they might do.

CONVERSELY, an admiral would be courting disaster by using his fleet to force a landing, or cover an evacuation of troops, within easy range of a powerful enemy air base. Only an emergency would justify the hazard. It is a comforting thought that an invader's fleet would face the same warm reception from our own army's flying-fortress bombers.

But this country's grand strategy differs as much from that of Europe as the vast oceans that lap our shores contrast with land-locked European waters. For our defense, we picture *(Continued on page 228)*

Uncle Sam Vacuum-Packs His Gas Masks



Workers assembling gas masks at the Edgewood, Md., arsenal. At right, a container is being placed in a compressor for sealing

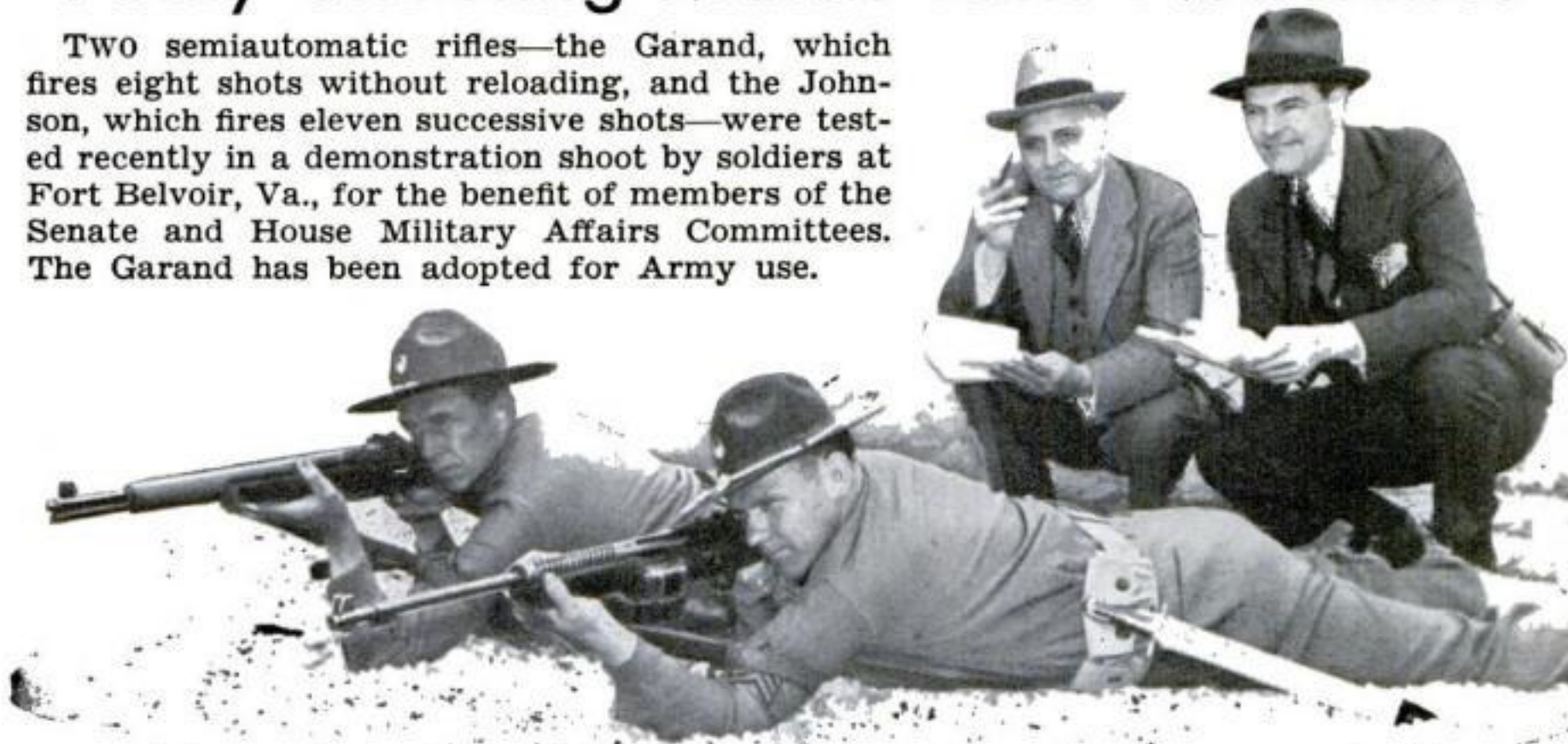


TO KEEP them in first-class condition for periods as long as thirty years, gas masks being manufactured at the U. S. arsenal at Edgewood, Md., are sealed in special vacuum containers. After the masks have been assembled and tested, they are placed in corrugated metal containers. These are fed into a compressing machine which removes all air from the container and seals a metal lid in place. To make doubly sure that no air leaks in, the sealed containers are then soldered at the joints. Eight hundred work-

ers at the Edgewood plant are turning out masks at the rate of about 3,000 a day to build up a huge reserve supply for possible future need. The photograph at the left, above, shows women workers on the assembly line attaching canisters to the otherwise completed masks, while in the picture at the right a workman is shown placing the mask-filled container in the compression machine for sealing.

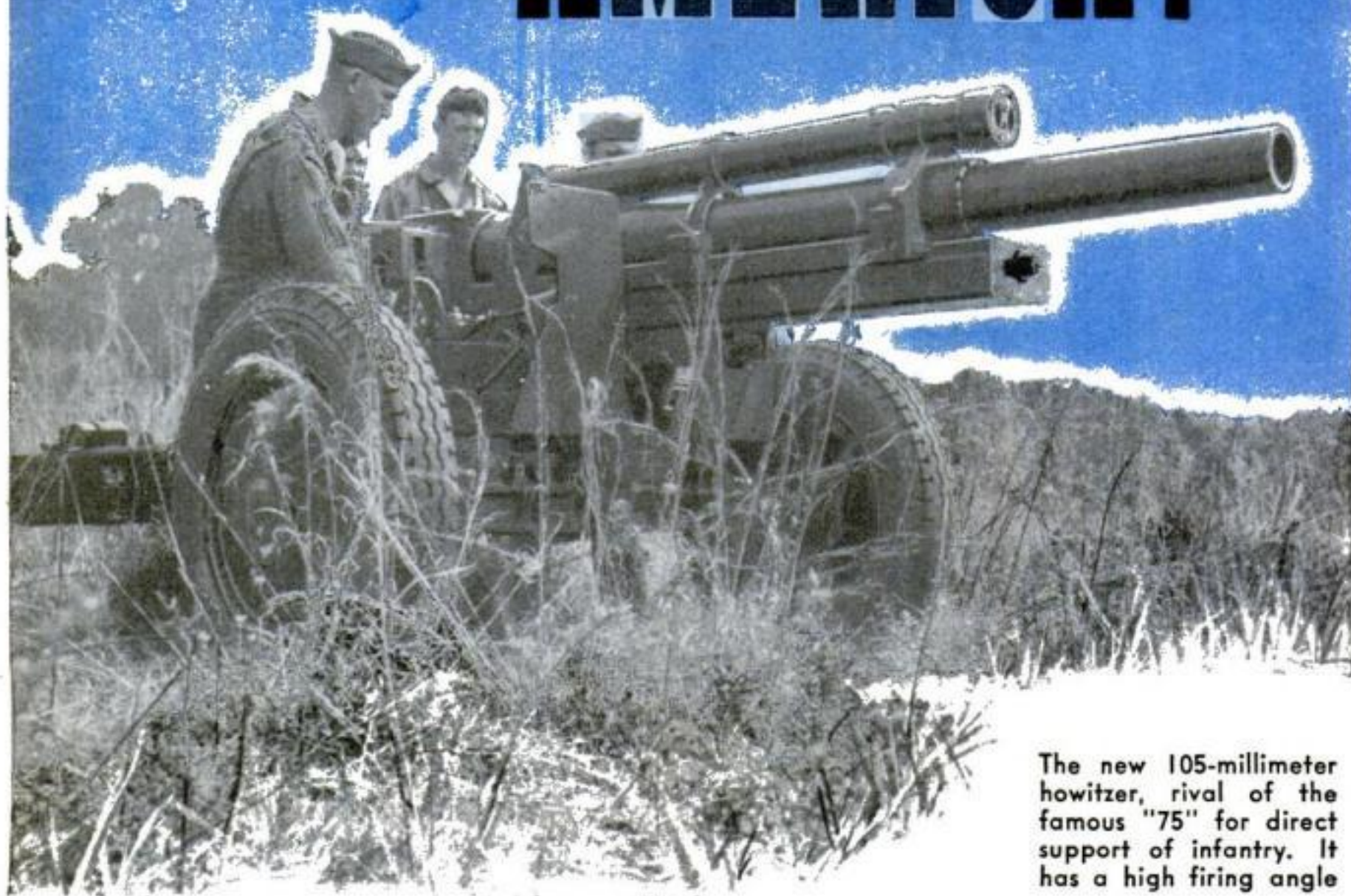
Army Shooting Match Tests New Rifles

Two semiautomatic rifles—the Garand, which fires eight shots without reloading, and the Johnson, which fires eleven successive shots—were tested recently in a demonstration shoot by soldiers at Fort Belvoir, Va., for the benefit of members of the Senate and House Military Affairs Committees. The Garand has been adopted for Army use.



Congressmen keep score as doughboys put the Garand and Johnson rifles through their paces

More Guns To Defend AMERICA!



The new 105-millimeter howitzer, rival of the famous "75" for direct support of infantry. It has a high firing angle

NO ONE ever heard a fighting soldier complain that his army had too much artillery!

To most Americans, and even to some American Army officers, last spring's European war on land brought a succession of stunning surprises. The defense-numbing effectiveness of attacks by massed tanks, the tremendous hitting power of armored divisions, breath-taking successes won by dive bombers, spectacular achievements by dare-everything parachute troops, insidious behind-the-lines activities of fifth-column agents—these developments in the ancient and sometimes honorable trade of war resulted in a quantity of hard thinking by American officers. One of the effects has been a mental rush toward mechanized war weapons, the mere mention of which only a year ago would have made the faces of traditional-minded infantry colonels and hard-swearing cavalry brigadiers turn purple with rage.

Perhaps in a few cases this trend toward mechanization has hardened into a dangerous belief that mechanized weapons in themselves are a solution of all the complex problems of model-1940 war. But most of our officers, no matter to which arm of the service they may belong, have refused to become blind worshippers at the shrine of the militarized monkey wrench. They appreciate fully the value of the new war machines, but that appreciation hasn't shaken their conviction that the time-tested combat team of infantry and artillery remains the backbone of every army, and that only artillery can make it possible for attacking infantry to advance and for defending infantry to hold its ground.

Adequate artillery support in battle usually means comparatively light infantry losses. The regular artillery armament of our big World War divisions of close to 30,000 men consisted of forty-eight 75-millimeter guns and twenty-four 155-milli-

meter howitzers. It was so inadequate that whenever an infantry division was called on to make an assault, its artillery had to be reinforced by the artillery of a division in reserve. Even then, infantry assaults didn't always succeed, and infantry losses too often were high. But when the artillery of *three* divisions was used to support the advance of the infantry of one, success came quickly and the infantry's losses were light.

The war strength of our Regular Army's new triangular or streamline division is about 12,500 men. Its three small regiments of infantry are armed with semiautomatic rifles, machine guns, mortars, and 37-millimeter anti-tank guns. Its artillery consists of a regiment of thirty-six 75-millimeter guns and a regiment of sixteen 155-millimeter howitzers.

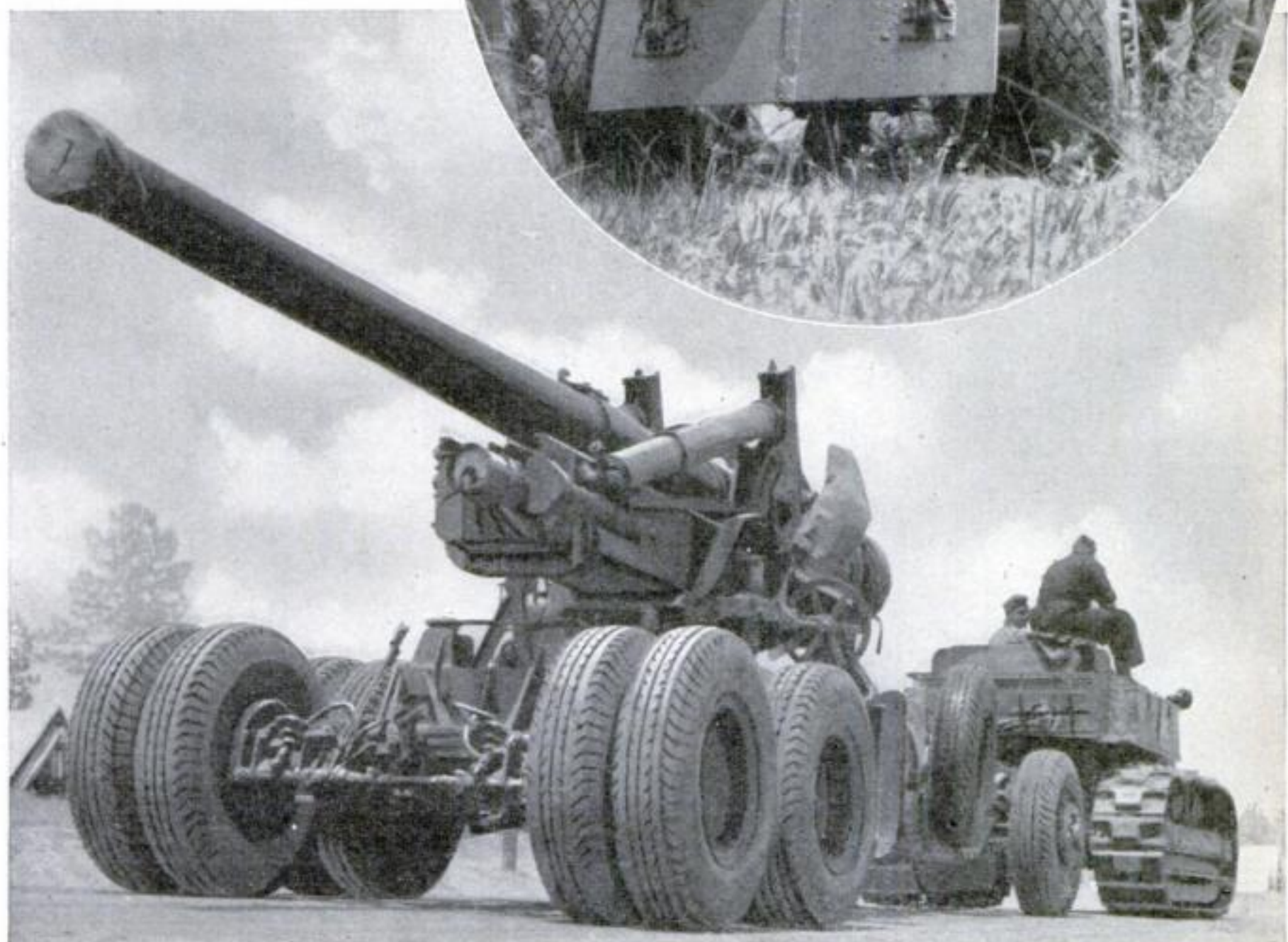
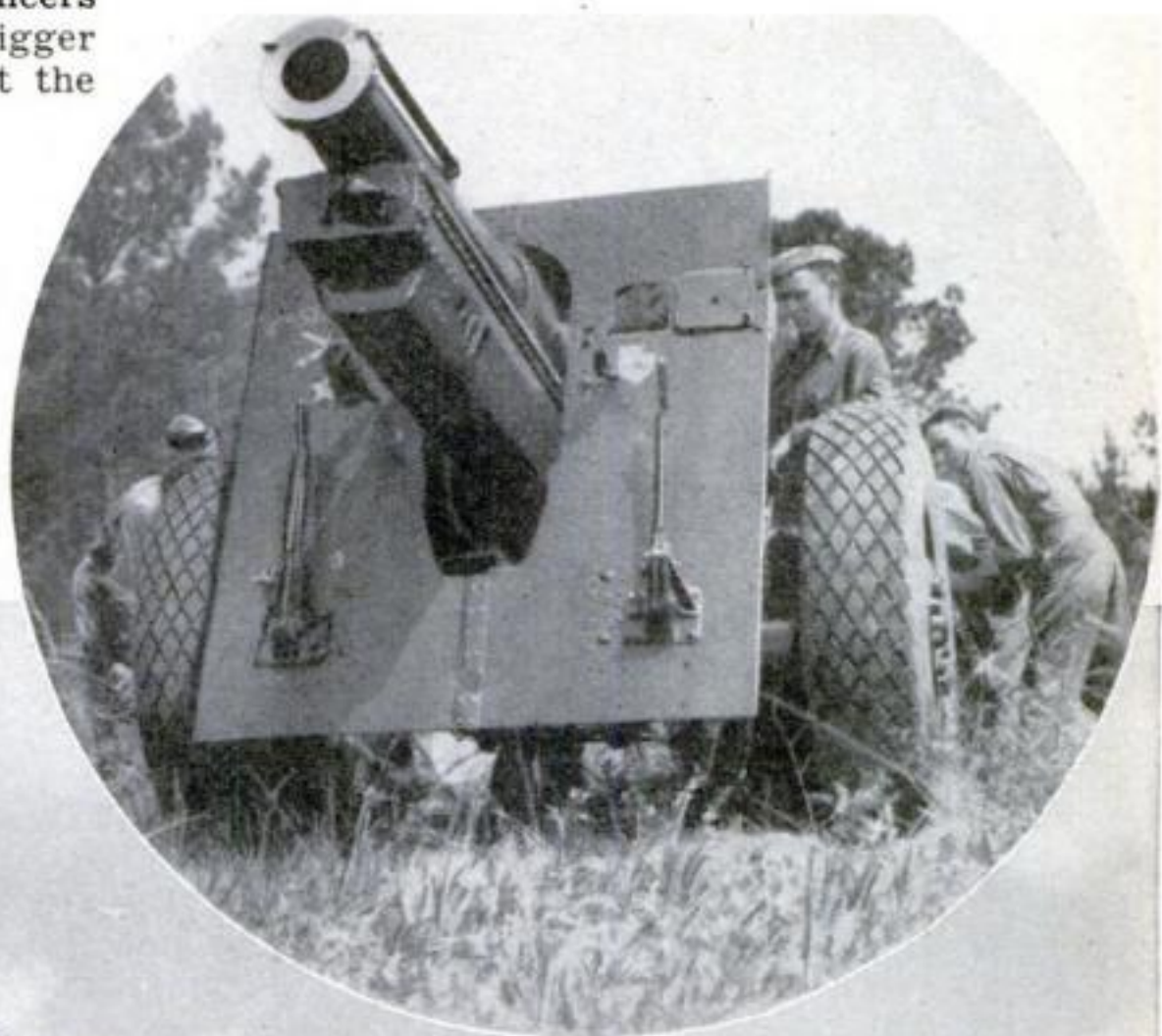
Outspoken high-ranking officers say that we need more and bigger guns in our divisions, and that the

very least we should do is to increase the number of 155-millimeter howitzers from sixteen to twenty-four. We're a rich country—rich enough to buy all the guns we need to defend ourselves against any enemy, but not rich enough to pay for the life of a single soldier killed unnecessarily because we fail to see to it that the Army get the guns it needs to do its national-defense job!

At present our standard light-artillery weapon is the 75-millimeter—about three-inch—gun. Contrary to common belief, the guns our army is using today aren't the famous French-built 1897-model "75's" with which we fought in France, but guns built from French designs in American Army

By
ARTHUR GRAHAME

Our medium field guns: 155-millimeter howitzer (right) and new gun of same caliber





Motorized light artillery on the march. A regiment of thirty-six 75's has a train of 110 vehicles

arsenals late in the World War and shortly after it. With the original carriage they had a maximum range of five and a half miles. With the new American-designed M-2 high-speed carriage, which permits an elevation of forty-five degrees and a traverse of eighty-five degrees, their range is over seven and a half miles.

The Army has a stock of well over 4,000 of these guns. Some are being used by the Regulars and the National Guard, and the rest are in storage. Although they are old enough to vote, most of them are as good as they were the day they were finished. Modernized with the M-2 carriage at a cost of about \$8,000 each, they are the equals of any guns of their caliber in the world.

All our field artillerymen speak affectionately of the "75," but not all of them are convinced that it is the best possible weapon for its primary purpose—the direct support of infantry with its fire. Many of them think that the new 105-millimeter howitzer, designed and after several years of experimenting recently perfected by our Ordnance Department, is more effective.

The greatest advantage of the 105 over the 75 is the larger bursting charge of its shell. A battery of four 75's can cover a front of 120 yards with its fire; a battery of four 105's can cover a front of 160 yards. It takes an average of 800 fifteen-pound 75-millimeter shells to blast a lane thirty yards wide through a barbed-wire entanglement thirty yards deep and 4,000 yards away; an average of 525 thirty-three-pound 105-millimeter shells will do the job.

Another advantage of the 105 is that in hilly or broken-up country its high-angle fire can reach targets which the flat-trajectory 75 gun can't touch. One of the disadvantages of the 105 is that it weighs a ton more than the 3,650-pound 75, and so can't be moved quite so fast. Another is that its heavier ammunition requires more motor transportation—and even a regiment of truck-drawn 75's has to have 110 vehicles to carry its men and equipment and 120 rounds of shell for its thirty-six guns!

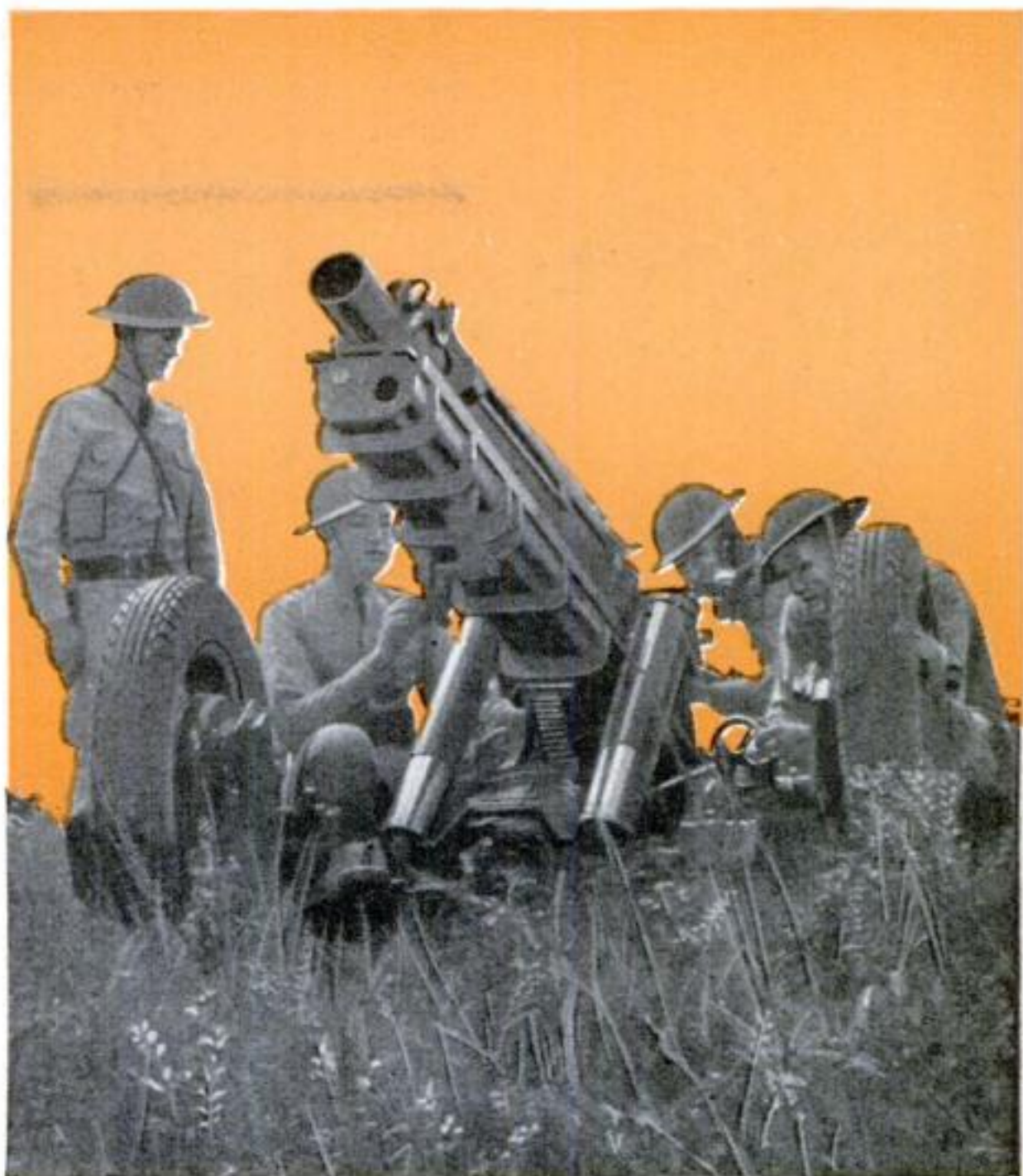
The potency of the 75 as a tank killer is a strong point in its favor. The French did great work with it against the German heavy tanks which their 37-millimeter anti-tank guns couldn't do more than dent. Umpires at our maneuvers always flag down a tank, and count it a casualty, if it is unwise enough to make a target of itself within 1,000 yards or so of a 75 in firing position.

○ OUR other light-artillery weapon is the 75-millimeter howitzer, also poison to tanks. Hauled swiftly on the road or across country by half-tracks, it gives artillery support to our Mechanized Cavalry Brigade. It also is built in a pack model weighing only 1,470 pounds which, taken apart, can be carried by six mules. Throwing a fifteen-pound shell well over five miles, this pack howitzer would be a mighty useful weapon if we ever had to fight in the sort of rough country which is common in some of our outlying possessions and in the vicinity of the Panama Canal.

Our medium artillery consists of an undisclosed number of 155-millimeter howitzers—modernized four-ton World War guns which fire a ninety-five-pound shell seven miles, and which, towed by trucks, can do about 140 miles a day on the road.

NEWEST and longest-ranged of our heavy-artillery weapons is the fifteen-ton 155-millimeter gun, which has a range of fifteen miles. Towed by tractor, it can be moved 100 miles a day. French-built World War guns of the same caliber, which we still have in service, have a range of ten miles. Our heaviest field gun is the 240-millimeter howitzer—a tractor-hauled thirty-ton monster which throws a 345-pound shell nine miles.

There still are some field-artillery regiments whose guns are galloped into action to the stirring accompaniment of thudding hoofs and rumbling wooden wheels. In all probability, there will be a few of these picturesque horse-drawn-gun regiments in our Army for a good many years to come. There's plenty of rough country left in the Americas, and in real rough-country fighting a horse-drawn



Poison to tanks, our 75-millimeter howitzer has won its place as artillery support to hard-hitting "iron cavalry"

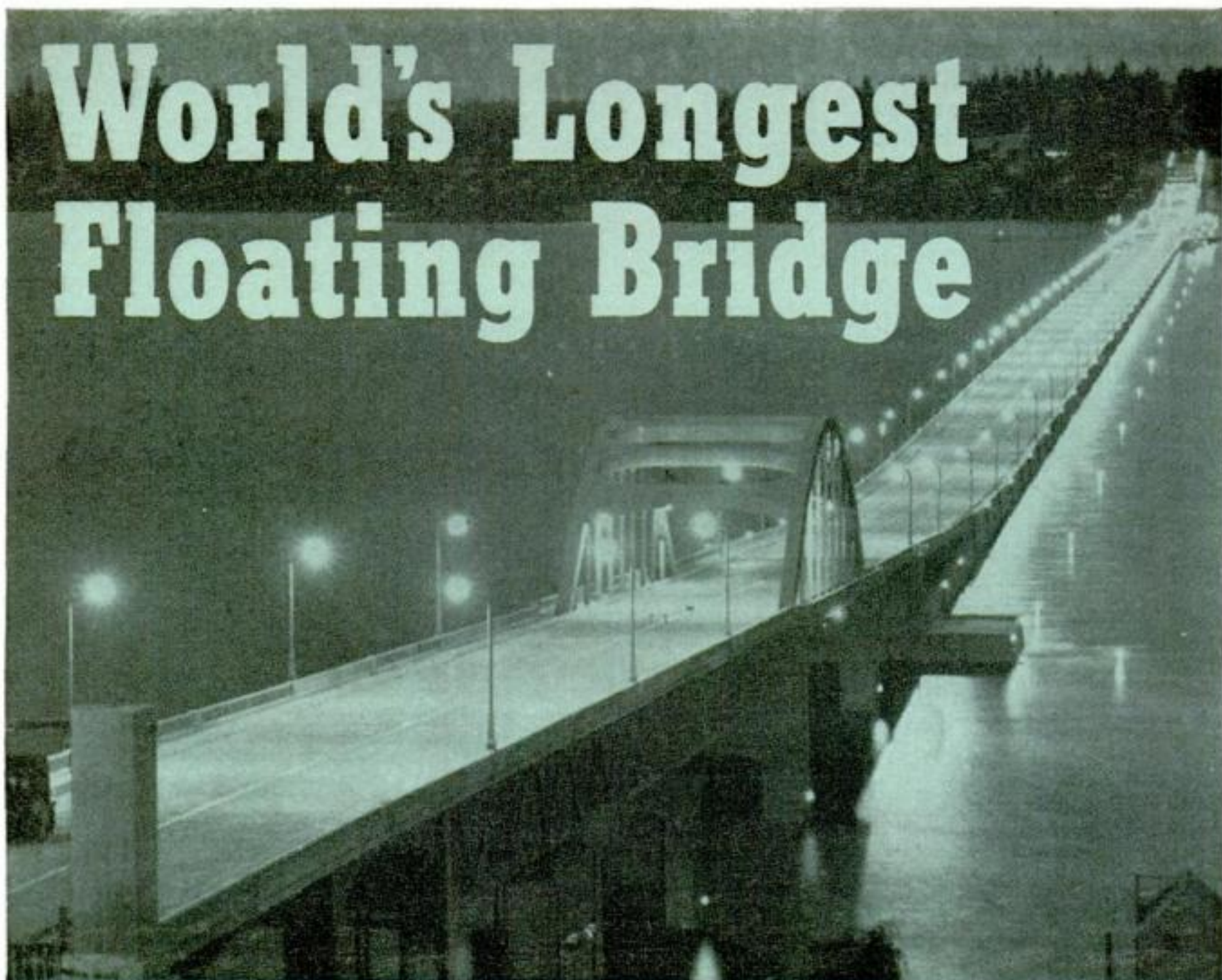
gun can move around faster than a truck-drawn gun. But almost three quarters of our light artillery has already been motorized, as well as all our medium and heavy artillery.

The reason for the change is that motorized artillery can move faster and farther on the road. With its six-horse team galloping, a seventy-five millimeter gun can be moved for a strictly limited distance at a top speed of about twelve miles an hour. A motor truck can haul a 75 mounted on a pneumatic-tired, high-speed carriage (*Continued on page 230*)



For rough country, a special model of the 75 howitzer is taken apart and carried on six army mules' backs

World's Longest Floating Bridge



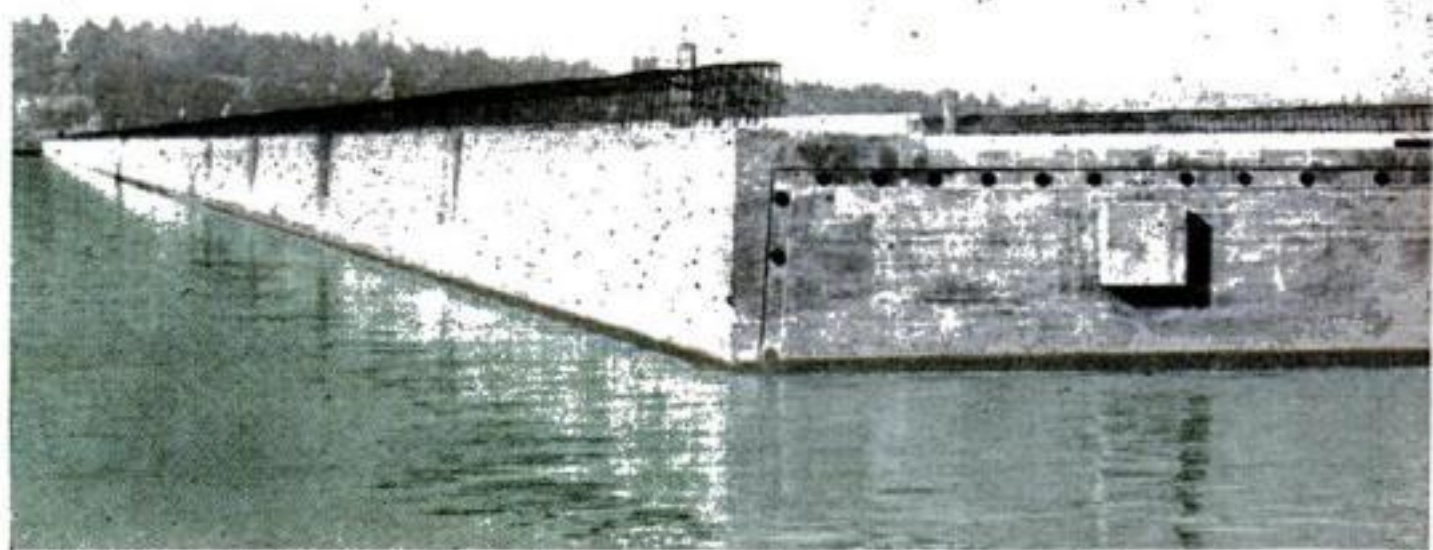
The 1¼-mile concrete pontoon bridge across Lake Washington as it appears when illuminated at night

TOLL gates swung open recently to mark the completion of one of the great engineering feats of all time—the daring construction of a mile-and-a-quarter vehicular bridge that floats on the surface of the water. Connecting the peninsular city of Seattle, Wash., with the mainland to the east, the floating bridge, by far the longest of its type in the world, is the key link in a \$9,000,000 highway project that also involves more than five miles of steel-arch bridge, viaducts, twin tunnels, and connecting highways. In effect, the project moves the city of Seattle fourteen miles eastward, since it provides a short cut for traffic to

and from the heart of the northwest metropolis.

Tied together with huge bolts, and anchored securely to the bottom of Lake Washington, twenty-five giant air-filled concrete pontoons form a broad four-lane thoroughfare. Cast in deep molds as large as a city block, the concrete pontoons were floated to the spot and bolted to each other, after engineers had completed long months of research on velocities of winds and waves, strength of the pontoons, expected weight of traffic, routes of water craft, and seasonal changes in the lake's water level. To tie the span down, construction experts used

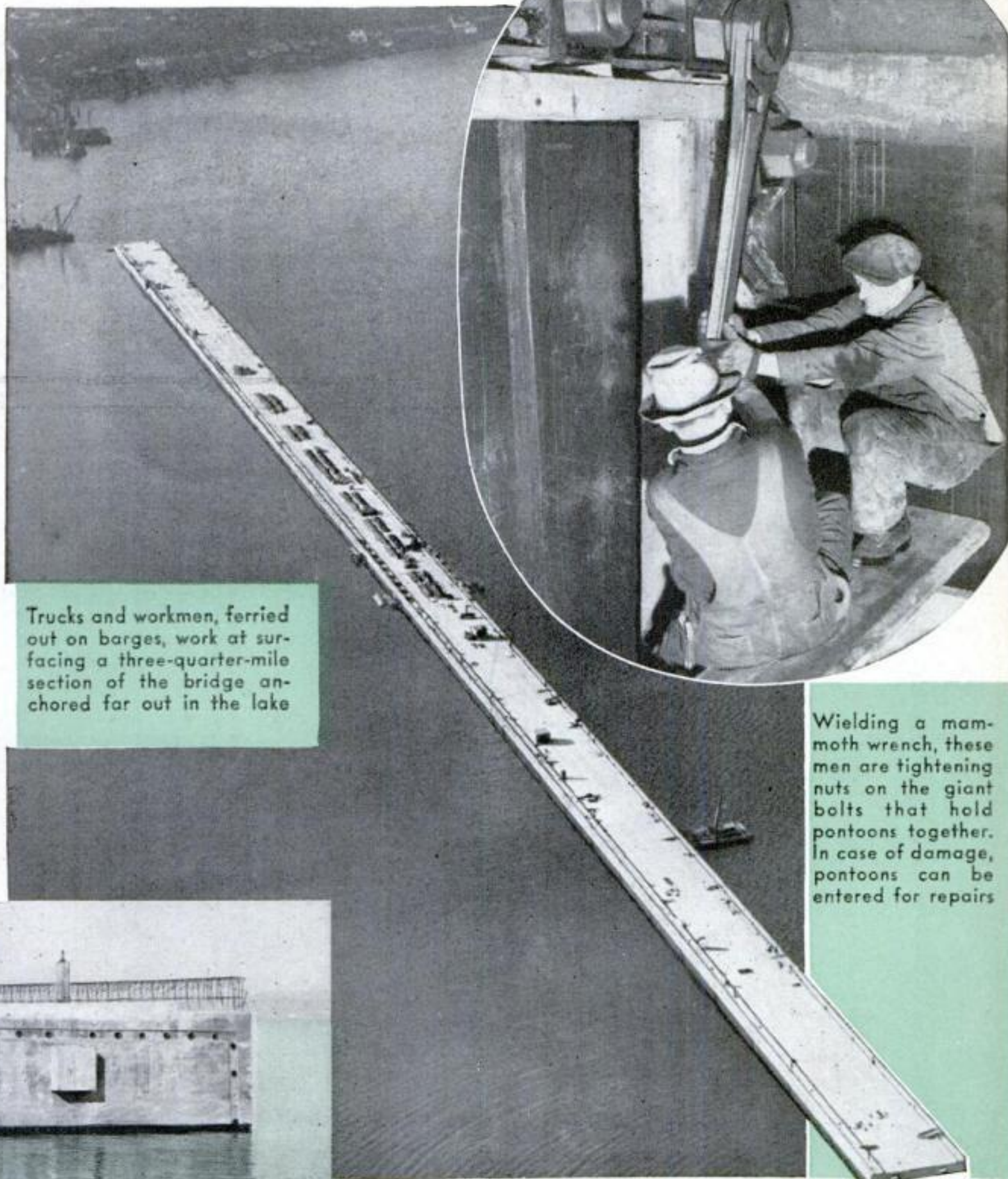
One of the sections of the sixty-foot-wide floating highway before it was locked into place. Note the tongues at the end, which fitted into grooves in the next section



forty concrete anchors, each tipping the scales at sixty-five tons and equipped with hydraulic nozzles by which they dug themselves deep into the soft lake bottom.

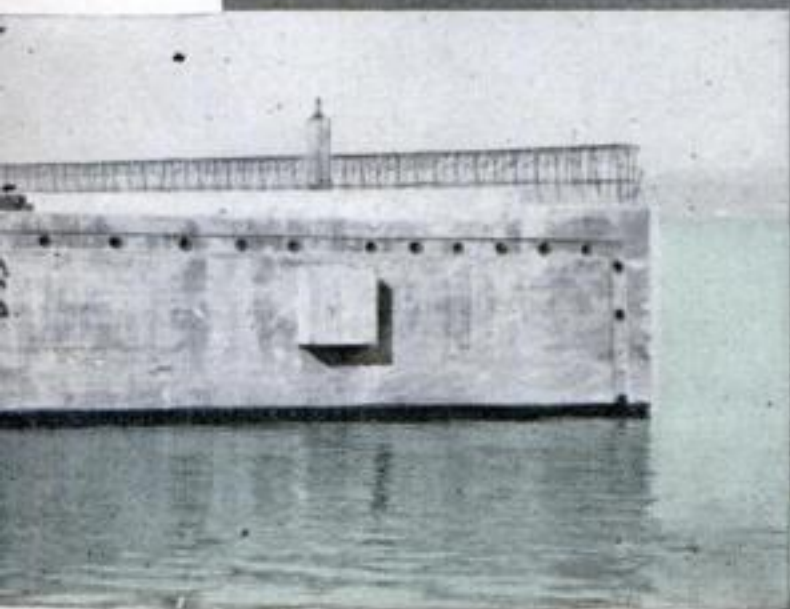
In its completed form, the floating bridge really has four solid, rigidly bolted sections. The middle section, a single concrete girder 4,520 feet long, is actually the longest boat in existence. The section near an island over which the bridge route passes, contains a 378-foot draw link, which can be opened to allow large ships to sail through (P.S.M., July '39, p. 82). Other sections connect with shore approaches, which provide 200-foot channels for small craft.

Special connections between the floating span and the shore approaches allow for contraction or expansion due to weather, for side motion of the span during violent storms, and for vertical movement caused by a rise or fall in the lake level. The water itself absorbs the weight and jar of traffic. Engineers figure that if all four eleven-foot lanes were jammed with loaded trucks, the bridge would sink into the water for a distance of only six inches.



Trucks and workmen, ferried out on barges, work at surfacing a three-quarter-mile section of the bridge anchored far out in the lake

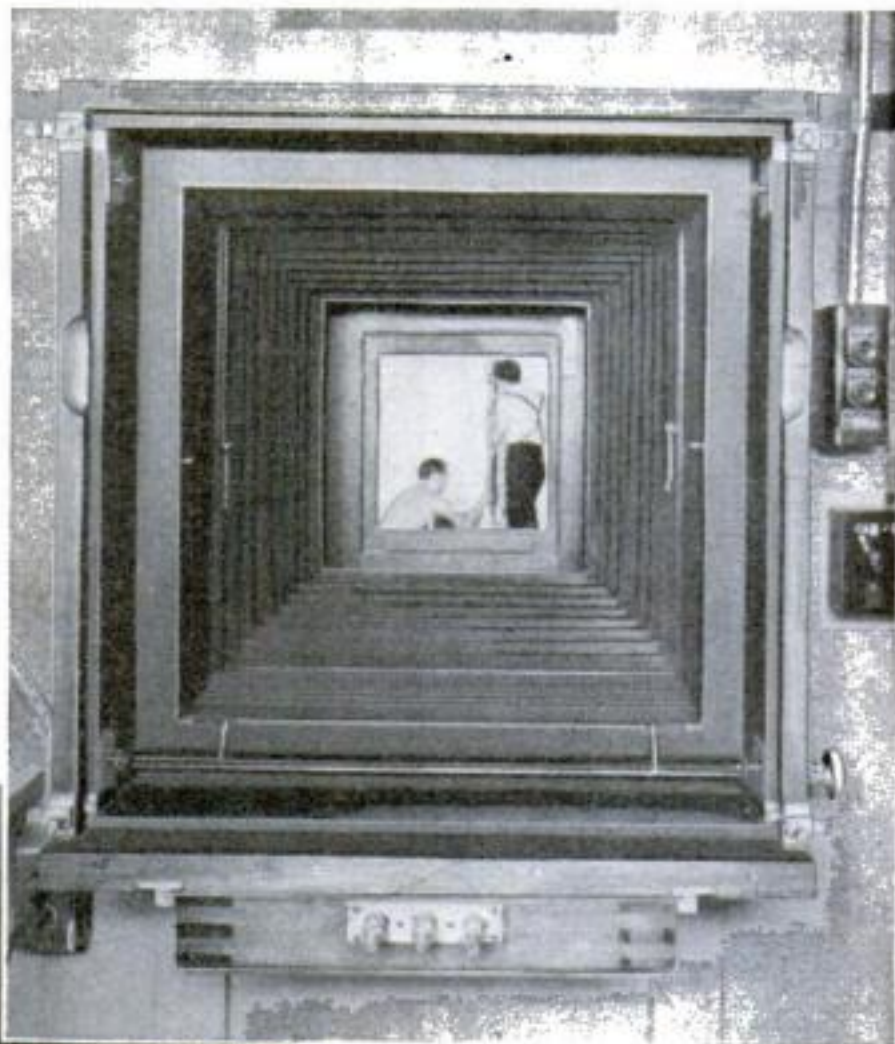
Wielding a mammoth wrench, these men are tightening nuts on the giant bolts that hold pontoons together. In case of damage, pontoons can be entered for repairs



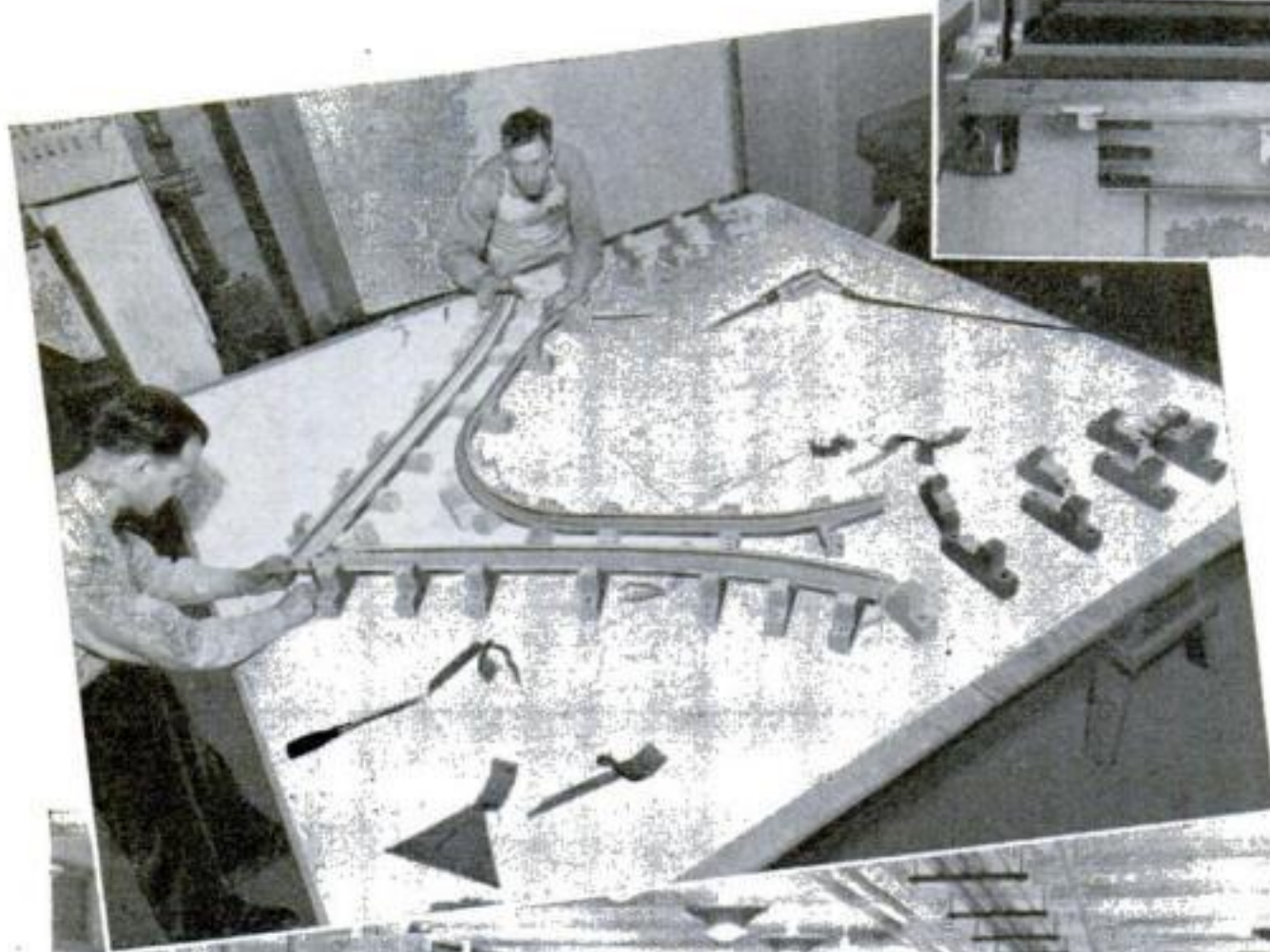
Photos Replace Airplane Plans

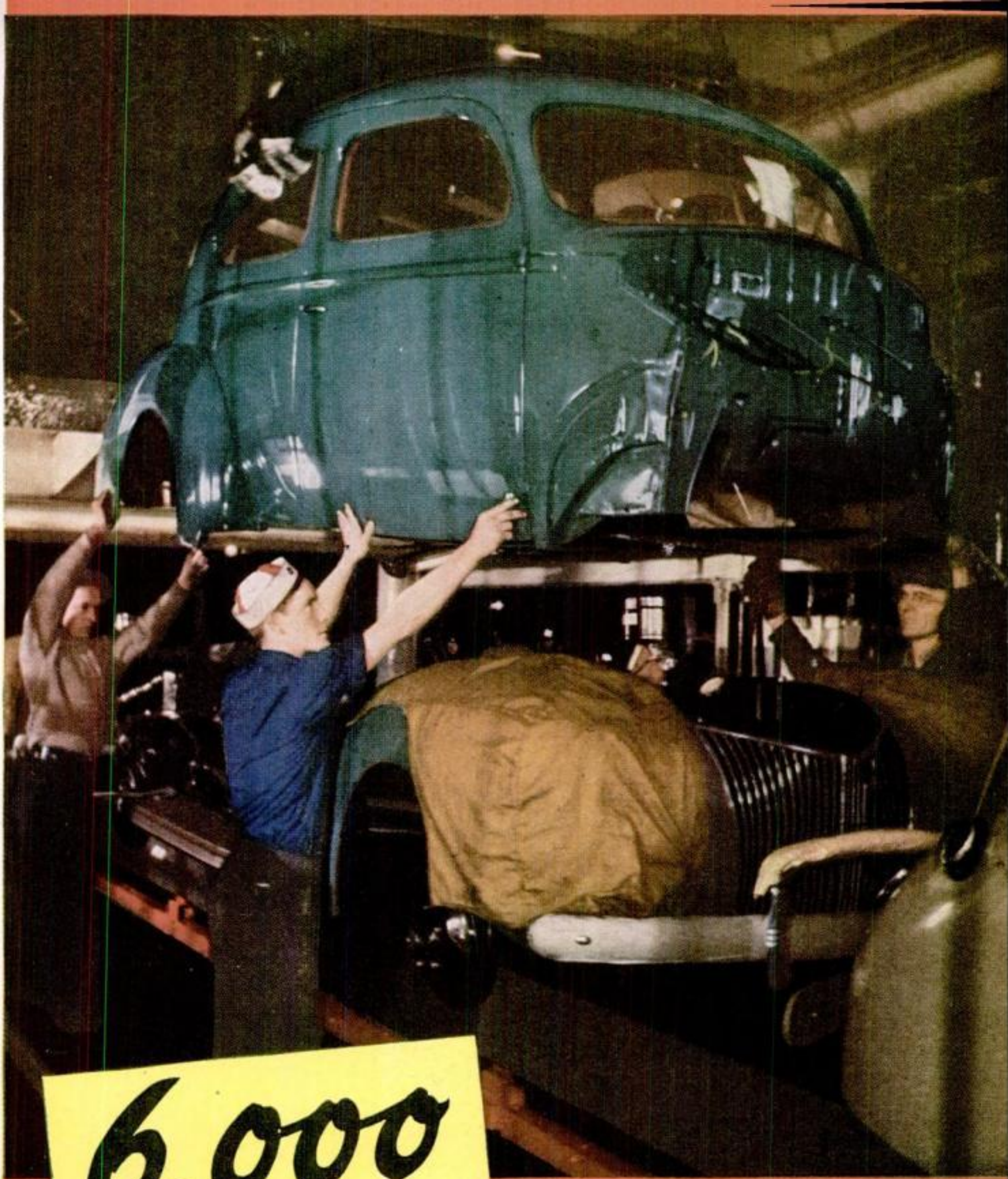
PHOTOGRAPHY on a giant scale is helping the Glenn L. Martin plant at Baltimore, Md., to play a leading part in speeding up national airplane production. No longer do craftsmen in shop and tool rooms work from scale drawings for parts, jigs, dies, or fixtures. On the raised floor of a spacious loft, engineers lay out whole airplanes and parts to actual size. Stress analysts fill in details. Then a huge camera photographs the design, section by section, on the same scale. Photographically sensitized sheets of aluminum, ranging up to five by ten feet in size, serve as "plates" for the camera. When they have been developed, finished or semi-finished work may be laid directly on the aluminum photographs for checking dimensions. If desired, patterns and templates may be cut directly from the metal "snapshots." The camera may also magnify

drawings in order to allow for shrinkage in castings. It is estimated that the new process is saving \$80,000 a year at the Martin plant in engineering costs.



This view through the bellows of the giant camera reveals experts setting up a huge drawing, made from a master plane part, for photographing. The negative then will be projected on a sheet of sensitized metal. Developed, the image is cut out, duplicating the part. Various steps of the work are seen at left and below

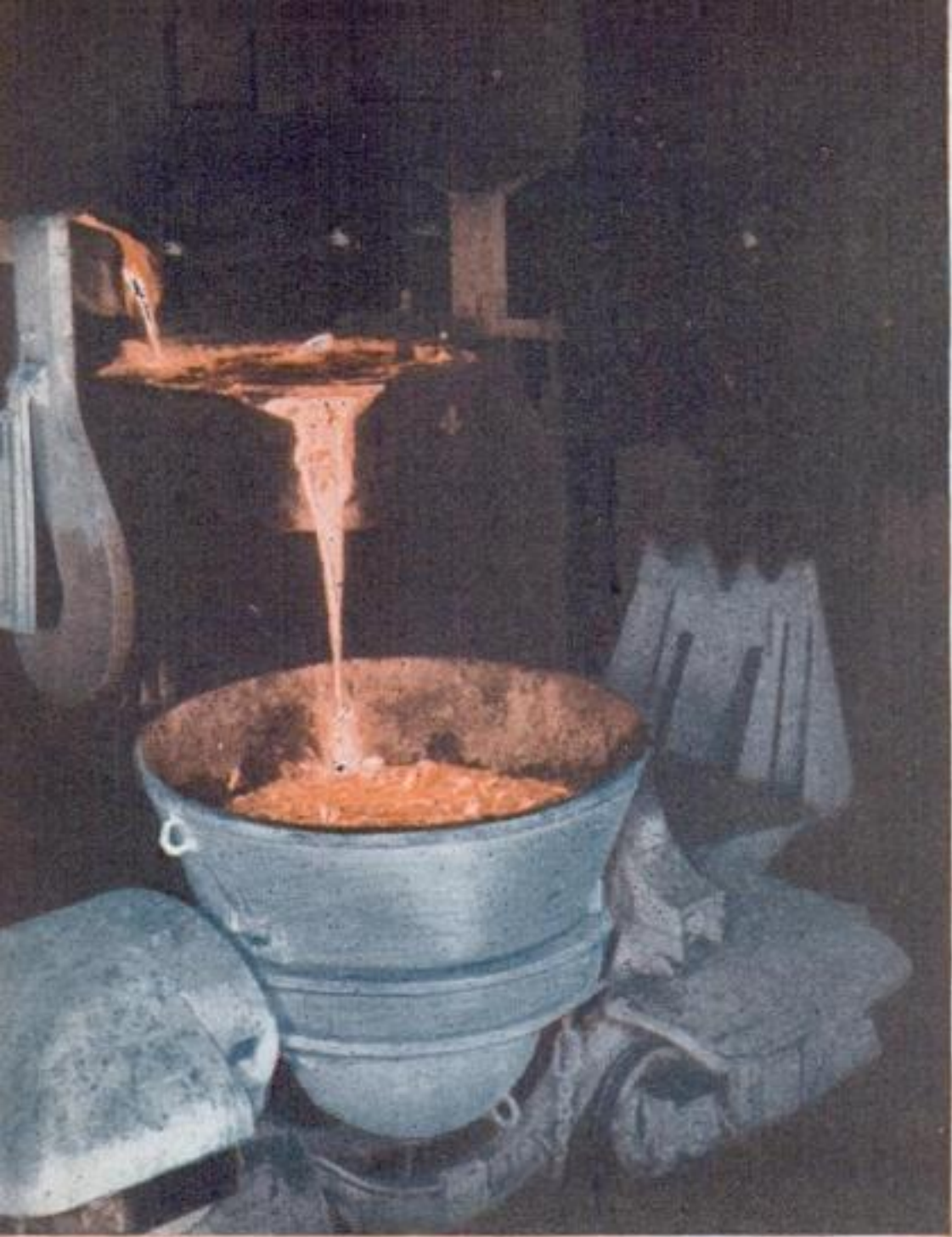




6,000
autos
a Day!

In the assembly line, the body of a new Ford is lowered onto the chassis

FIVE MILES west of the heart of Detroit, Mich., on the banks of the River Rouge, is the largest single manufacturing plant in the world. Sprawled over land that could accommodate more than 1,000 football gridirons, this Gargantuan factory employs 80,000 men and can turn out 6,000 automobiles in a single, two-



By E. W. MURTFELDT

shift, sixteen-hour day. That's better than one complete, ready-to-run car every ten seconds.

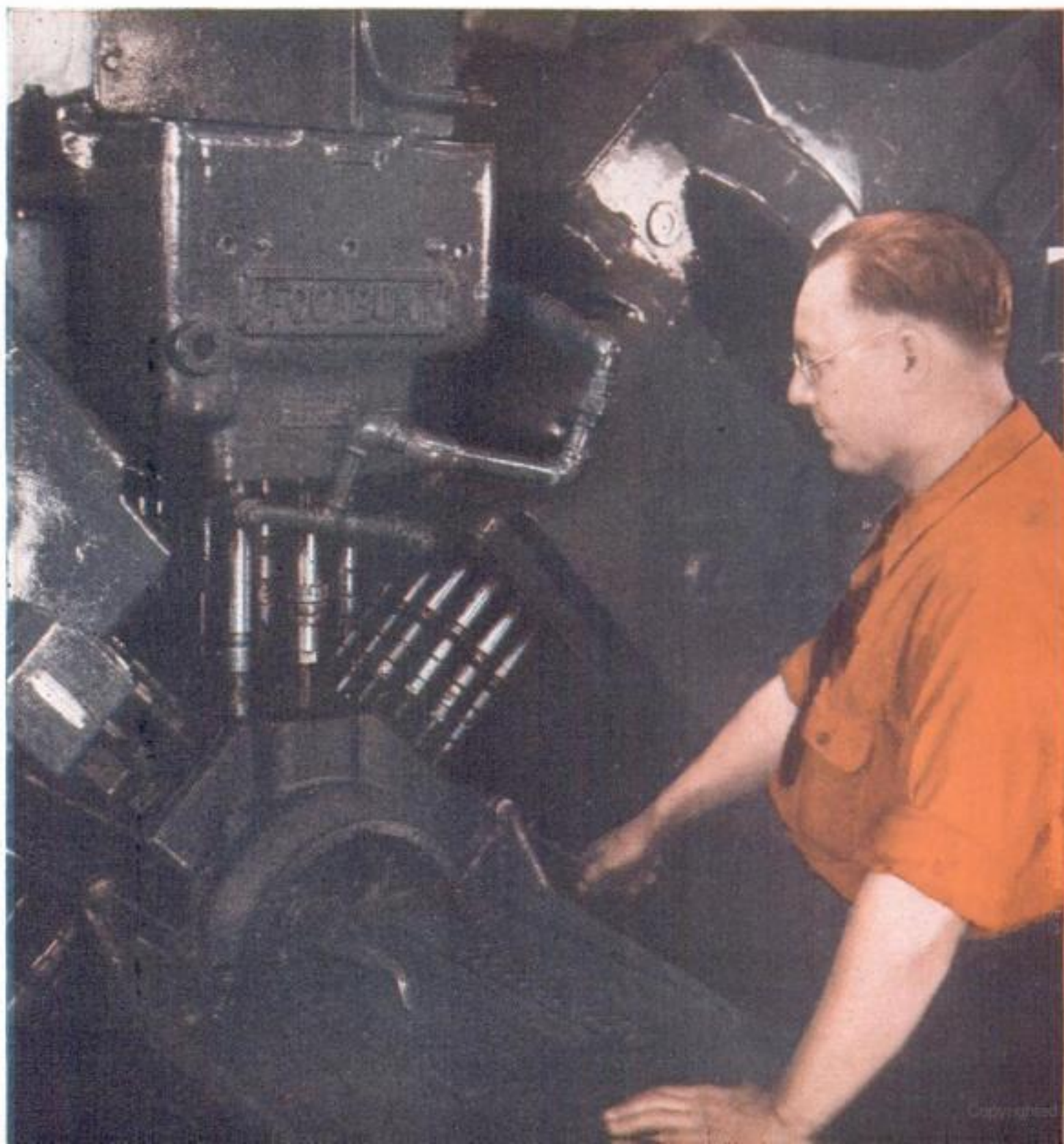
A bird's-eye view of the maze of blast furnaces, rolling mills, tool and die shops, power houses, ore docks, railroads, foundries, laboratories, and offices in this giant Ford Motor Company plant presents the first impression of one vast chaotic tangle. Yet, by a miracle of science and industrial organization, the sprawling parts are blended into a clockwork unit that at one end sucks in raw materials, and at the other blows out a steady stream of gleaming motor cars.

To get any idea of the tremendous size of this manufacturing monster, and of the miracle of production it accomplishes, you have to begin at the beginning, which means that you run into this fact: The origins of the vehicles that come from this mammoth mechanical hatchery are scattered over the face of the earth.

For the Rouge plant taps the raw-ma-

STEELS FOR CARS

Mammoth furnaces and foundries transform iron ore into steel and iron. Here steel pours from an open-hearth furnace



CYLINDER BLOCK

Cast in one piece, an eight-cylinder engine block is seen at the right in a multiple-spindle drill which drills and taps nearly fifty holes at once



The Diesel-powered lake freighter "Henry Ford II," flagship of the Ford fleet, unloading iron ore

terial resources of the world. Up from Brazil and the Far East come boatloads of raw rubber for tires and bodies. Down through the western Great Lakes flows a steady stream of long barges stuffed with iron ore for the blast furnaces. Coal trundles in from the South. So vast is the demand of the factory for materials, that officials state that the plant taps not only many foreign lands, but also practically every one of the 3,070 counties in the United States for at least one contribution to its finished product.

Trains and trucks haul their quota of materials to the plant, but the lion's share of the transportation job is intrusted to ships. The Ford company maintains its own freighter fleet of twenty-nine vessels, led by the 614-foot Diesel-powered flagship, *Henry Ford II*. Up the River Rouge, the freighter armada noses up to the factory's huge unloading pier, where giant mechanical fists grab fifteen-ton handfuls of iron ore and dump them into a vast storage bin that lines the side of the boat wharf.

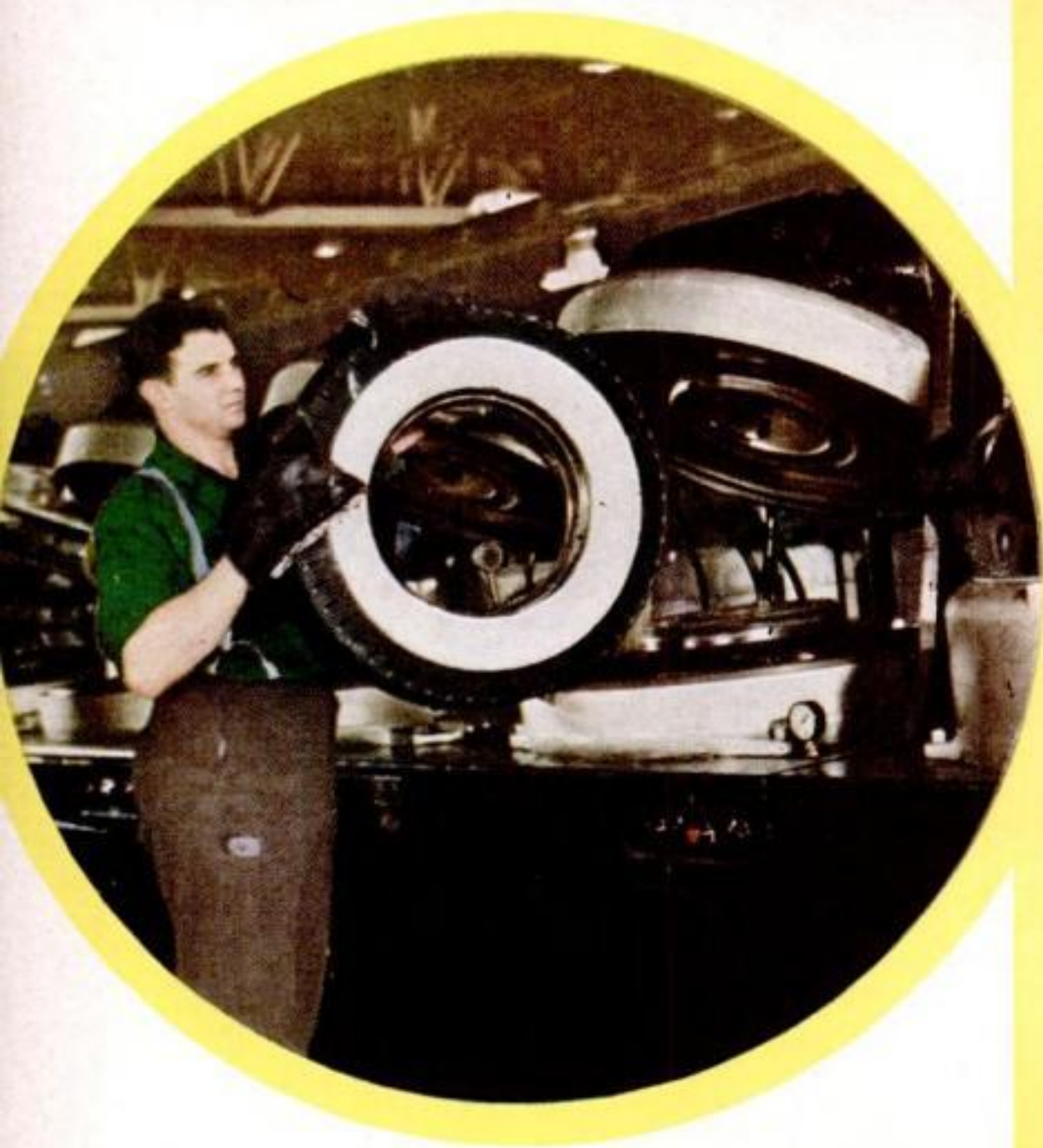
On schedule and without interruption, this influx of raw materials spreads out from docks and receiving platforms along transportation fingers that lead to the maze of manufacturing and processing plants. For this distribution job, there are 100 miles of

railroad track within the Rouge boundaries. Over this network of steel, ten steam locomotives and seven oil-electric engines haul more than 1,000 plant freight cars. There are fourteen giant locomotive cranes, as well as fleets of trucks, tractors, and trailers. And what this transportation army cannot handle is intrusted to a conveyor-belt system that is long enough to stretch from New York City to Wilmington, Del., and ranges from heavy mechanisms to move bulky raw materials, to light conveyors that speed small parts into the hands of workmen when and where they need them.

Either in their original or in their processed form, all these materials are ultimately destined for the spinal column of the factory, the final assembly line. But most of them face a long journey before they are joined to the automobile skeleton to play their part in forming the finished car.

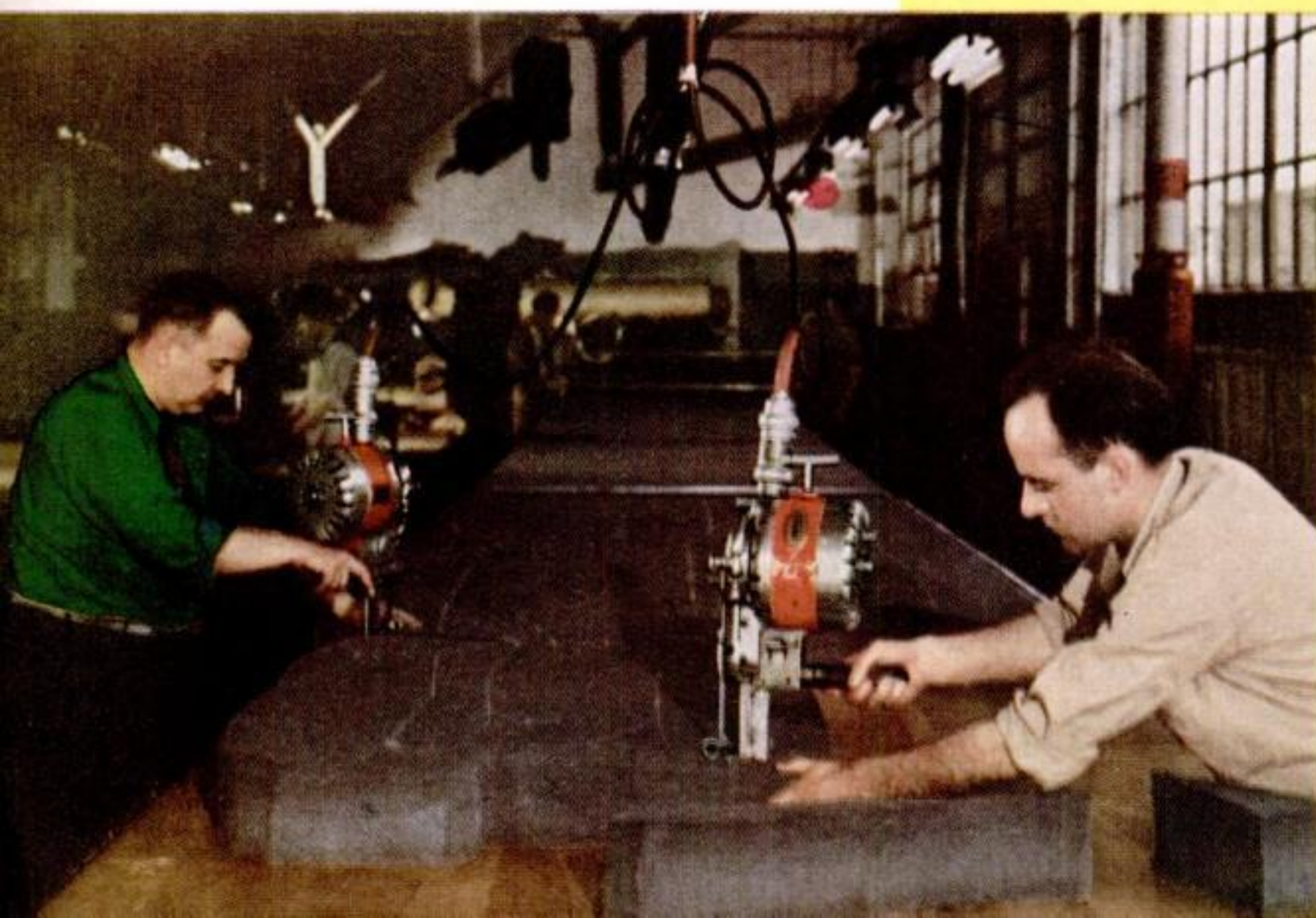
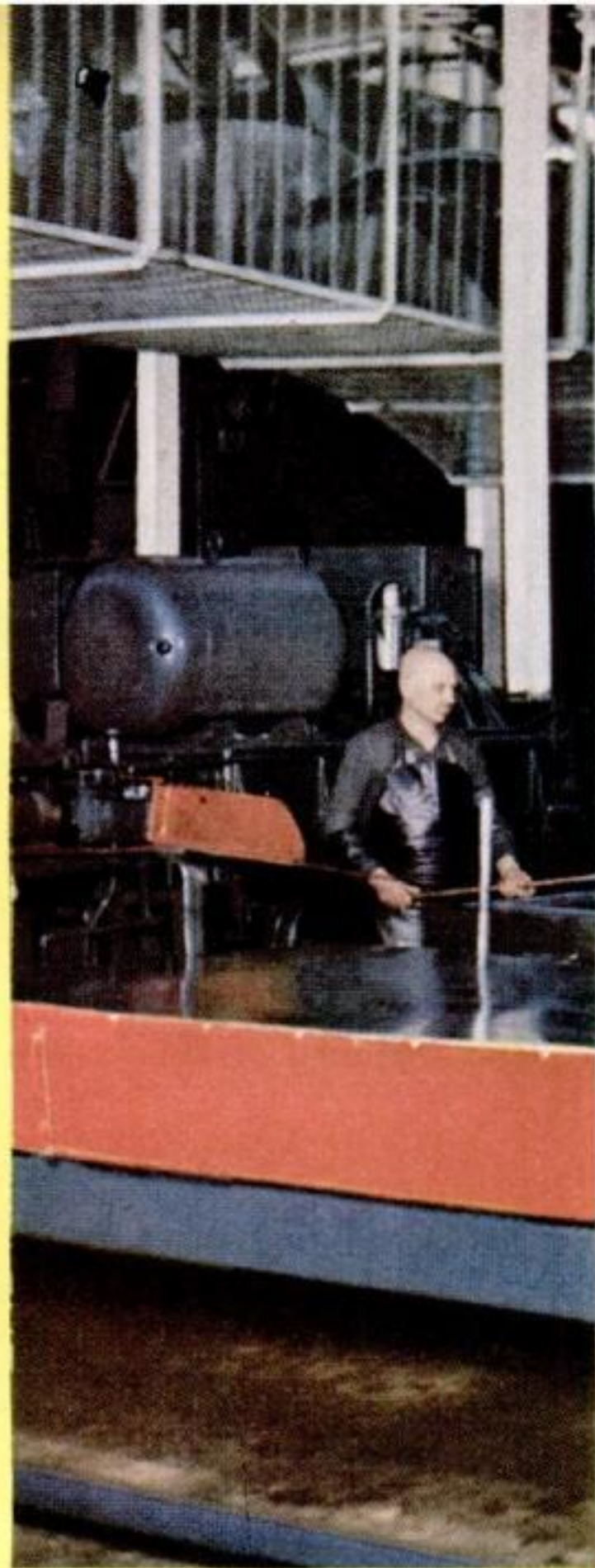
Take, for example, one raw material: iron ore, of which some 850,000 tons arrive at the Rouge docks in a single season. The raw ore is fed into the maws of two giant blast furnaces that in twenty-four hours can turn out 1,500 tons of pig iron. As it emerges, the flow splits, some of the iron moving into the seventeen-acre foundry to be made into

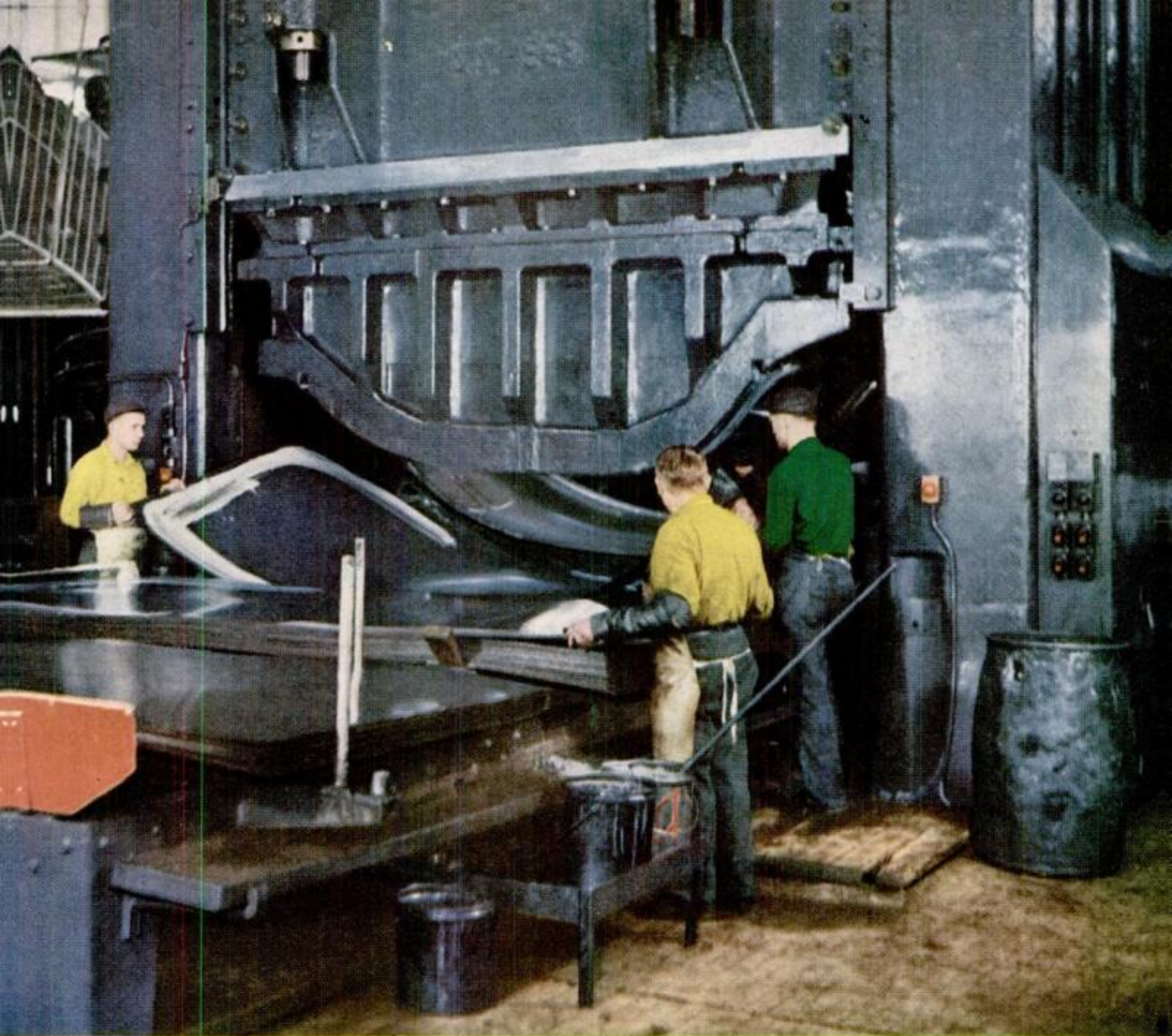
A VISIT TO AN INDUSTRIAL WONDERLAND ... THE LARGEST FACTORY IN THE WORLD



RUBBER FROM BRAZIL AND THE FAR EAST goes into the making of tires and of rubber body parts. Above, a worker in the huge new tire plant is seen removing a brand-new white-walled tire from the curing mold

MASS PRODUCTION OF UPHOLSTERY. Using electric knives, these workers in the upholstery plant are cutting fifty pieces of cloth at once for seat covers



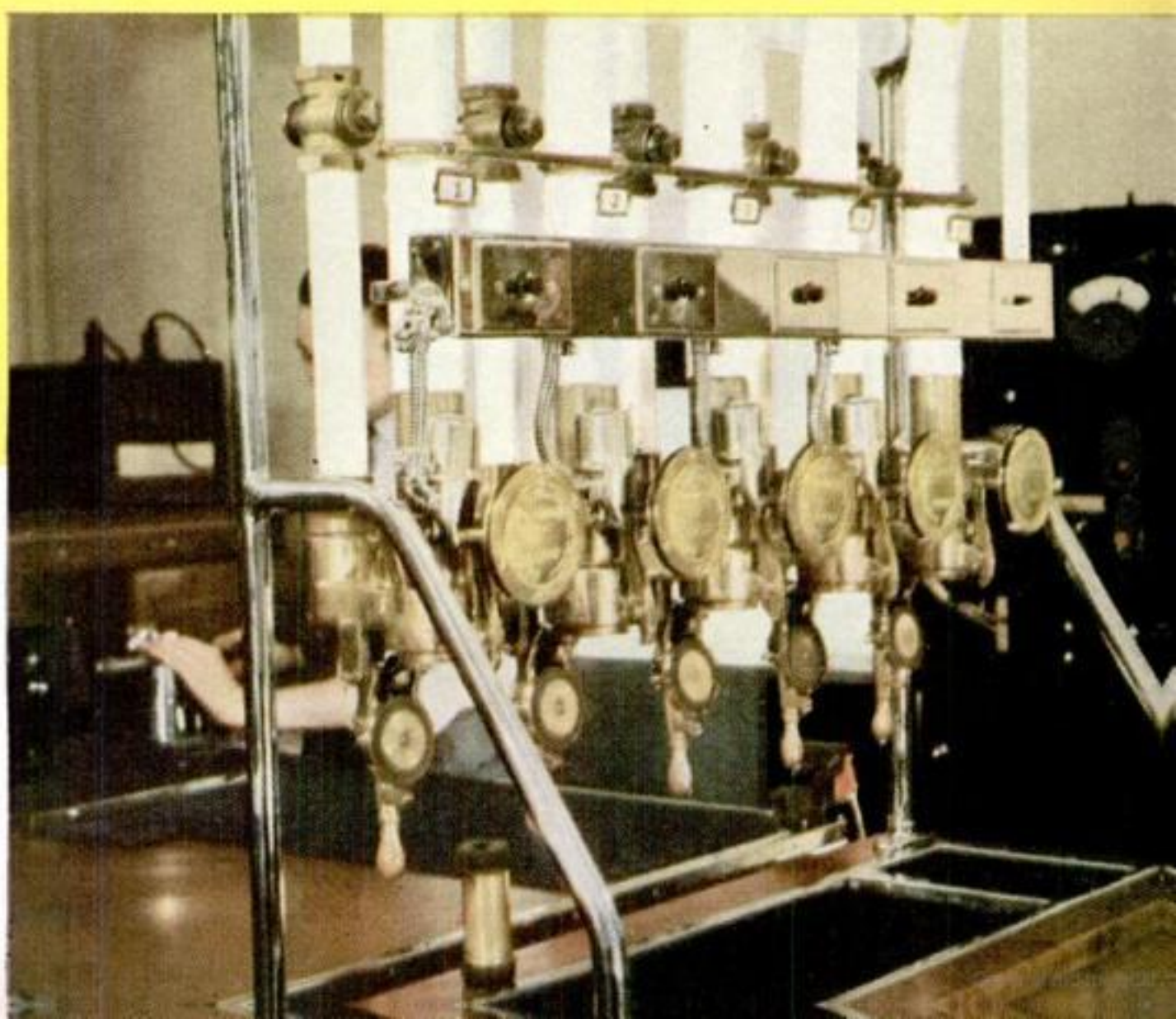


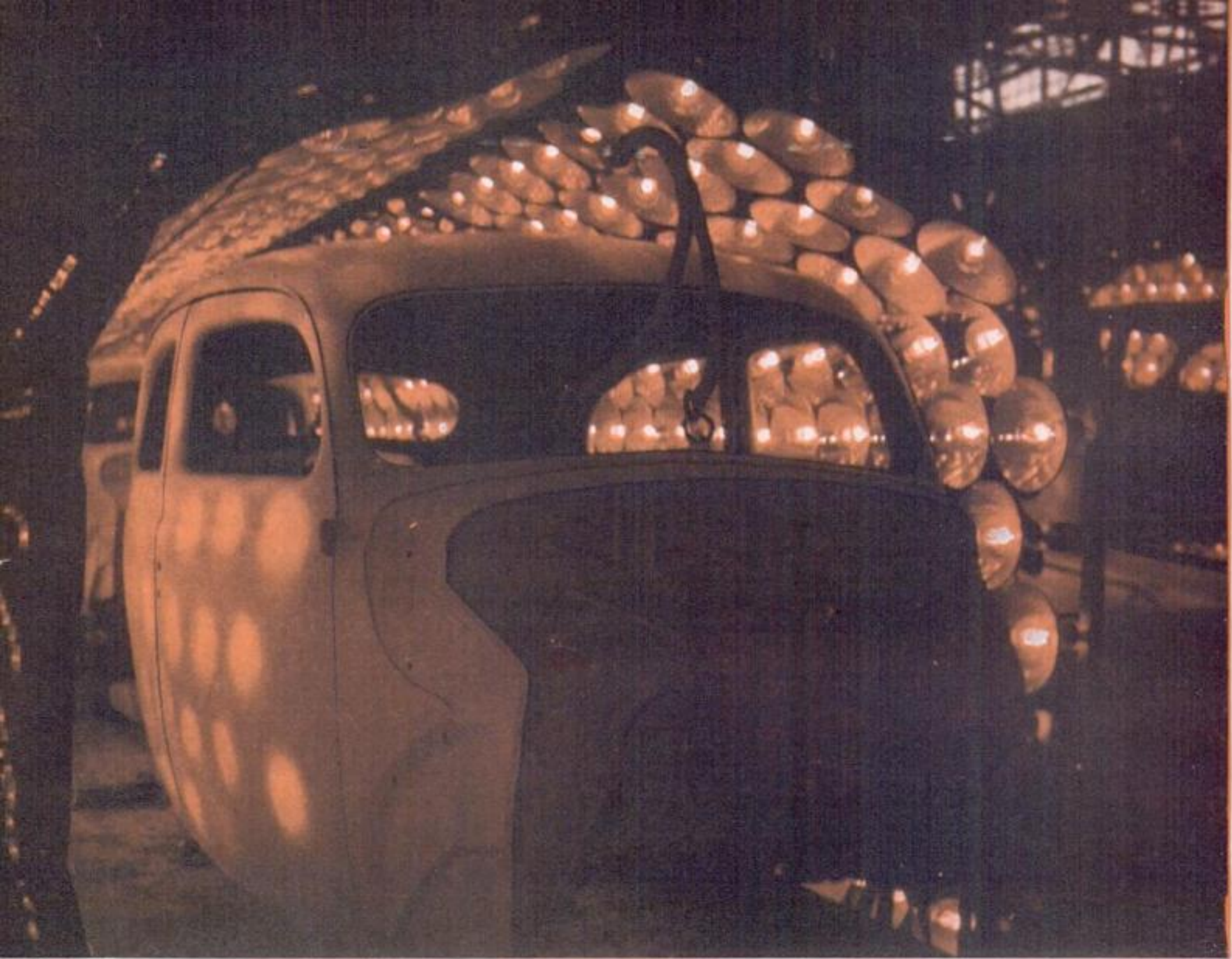
SHAPING THE BODY

Giant presses stamp large and small body parts from sheets of steel. The picture above shows how body tops are produced. There are 2,000 power presses, the most powerful of which exert an 800-ton pressure

PRECISION TESTING

The delicate instrument at the right is being used to gauge the thickness of the copper plating upon a connecting-rod bearing. This is one of the innumerable tests to maintain accuracy





"BAKING ON" THE BODY FINISH

After the body is assembled, it is cleaned and painted with a synthetic enamel, which is then dried by lamps as pictured above

castings, including the one-piece eight-cylinder Ford engine block.

Another stream of iron, in molten state, moves into the open-hearth building, where in ten huge furnaces it merges with scrap iron, limestone, magnesium, chrome, vanadium, and various other alloys to be converted into the sixty-three distinct types of steel that go into the manufacture of Ford-built cars.

Follow the trail farther. On conveyors, ingots of steel travel to the rolling mill—twenty-two acres—where gigantic machinery rolls them into bars or rods or wide coils of sheet steel. Go on into the press shop—nineteen acres—and watch a battery of 2,000 power presses, some exerting an 800-ton squeeze, stamp out fenders, hoods, radiators, body panels, and other parts, as easily as a chef wields a cookie cutter.

Near-by, in a connecting building, you'll watch forty steam hammers and sixty up-setters, a type of forging machine, turn out springs and small parts. Since the original

pig iron entered the open-hearth building, its progress has gone on in separate shops that are all connected and covered by a single roof, under which, if you wanted to sweep out a few thousand tons of machinery, you could lay out close to 1,000 tennis courts.

But you've only followed the factory trail of iron ore. To do the job right, you'd also follow raw rubber through its maze of transformations into finished tires. You'd follow silica and alkalis to their completed form as window and windshield glass. You'd travel through the plant where oil is extracted from soy beans to form a constituent of body enamel, and the remainder utilized in the manufacture of such plastic parts as distributor housings and ignition-coil cases.

But whatever material you follow, it will eventually wind up somewhere along one of the three parallel final-assembly lines. To get an idea of what these are like, think of a mammoth parade that starts with a small group at the beginning of an avenue that has side streets leading into it from the left. On each side street, groups of marchers are assembled into compact, orderly units. As the initial group reaches the first side street, the assembled marchers there swing into line.

A second group joins the parade at the next corner, and so on until the parade is a single marching unit.

The same thing happens in an automobile final-assembly line. Starting the parade is the chassis, which moves along on a conveyor until at the first "side street," the engine, assembled in the motor building, moves in on a conveyor from the left, and is lowered into place. Radiator, steering gear, fenders, wheels, bodies, and other parts are added as the steadily expanding unit moves from one side conveyor along to the next. And remember that each of these side-street conveyors is an assembly line in itself, for each major part has been built up from a number of smaller units. Finally, when the mechanism arrives at the end of the line, it is a complete, ready-to-operate automobile, and rolls off the conveyor under the guidance of an inspector, who drives it out onto a half-mile test track for a check run.

But long before you reach the point where finished cars roll off the assembly lines, you will probably reflect that it must take power with a capital P to run the thousands of machines and light the myriads of lamps in a plant of this size. It does. The factory power house, the largest industrial high-pressure power plant in the world, utilizes

three giant turbo-generators that can produce enough current in a single day to meet the electrical requirements of the average American home for 13,533 years!

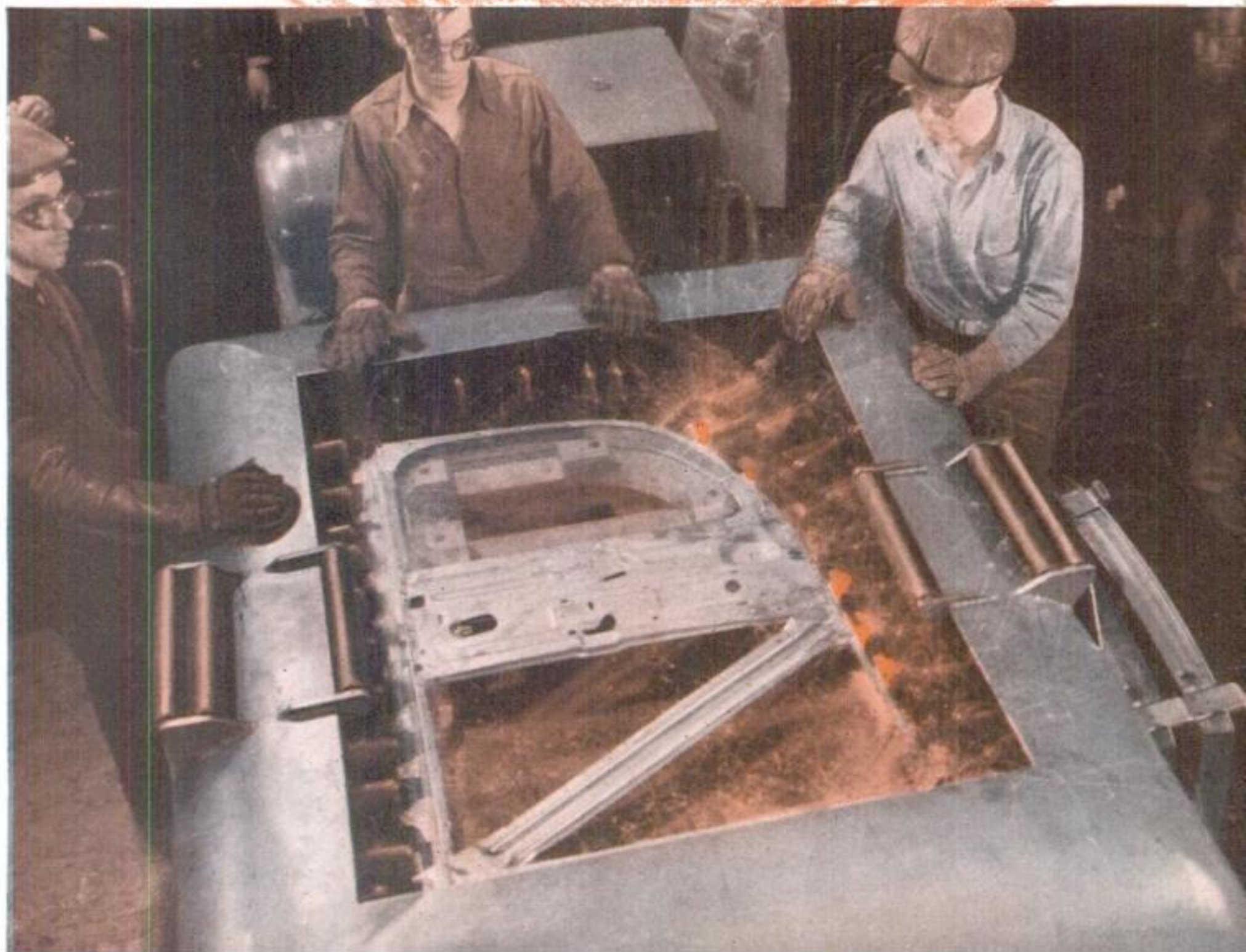
Coal, the principal power-house fuel, is used in pulverized form, and blown under pressure into the boilers where it burns almost like a gas. Every day the power house pumps water from the Detroit River through a 2½-mile tunnel in a quantity that equals the daily water consumption of the cities of Detroit, Cincinnati, and Washington combined.

These are facts and figures that set the brain whirling. So, before you leave the plant, perhaps you had better taper off with a few factory activities that Ford officials class as "incidentals." By-products, for example. Slag from the blast furnaces is not discarded but processed in a cement plant on the premises that has a daily capacity of 2,200 barrels. From the coke ovens come such by-products as coal tar, ammonium sulphate for fertilizer, light machine oil, and motor benzol, among others.

Or consider plant sanitation. Nearly 5,000

SPOT-WELDING A DOOR FRAME

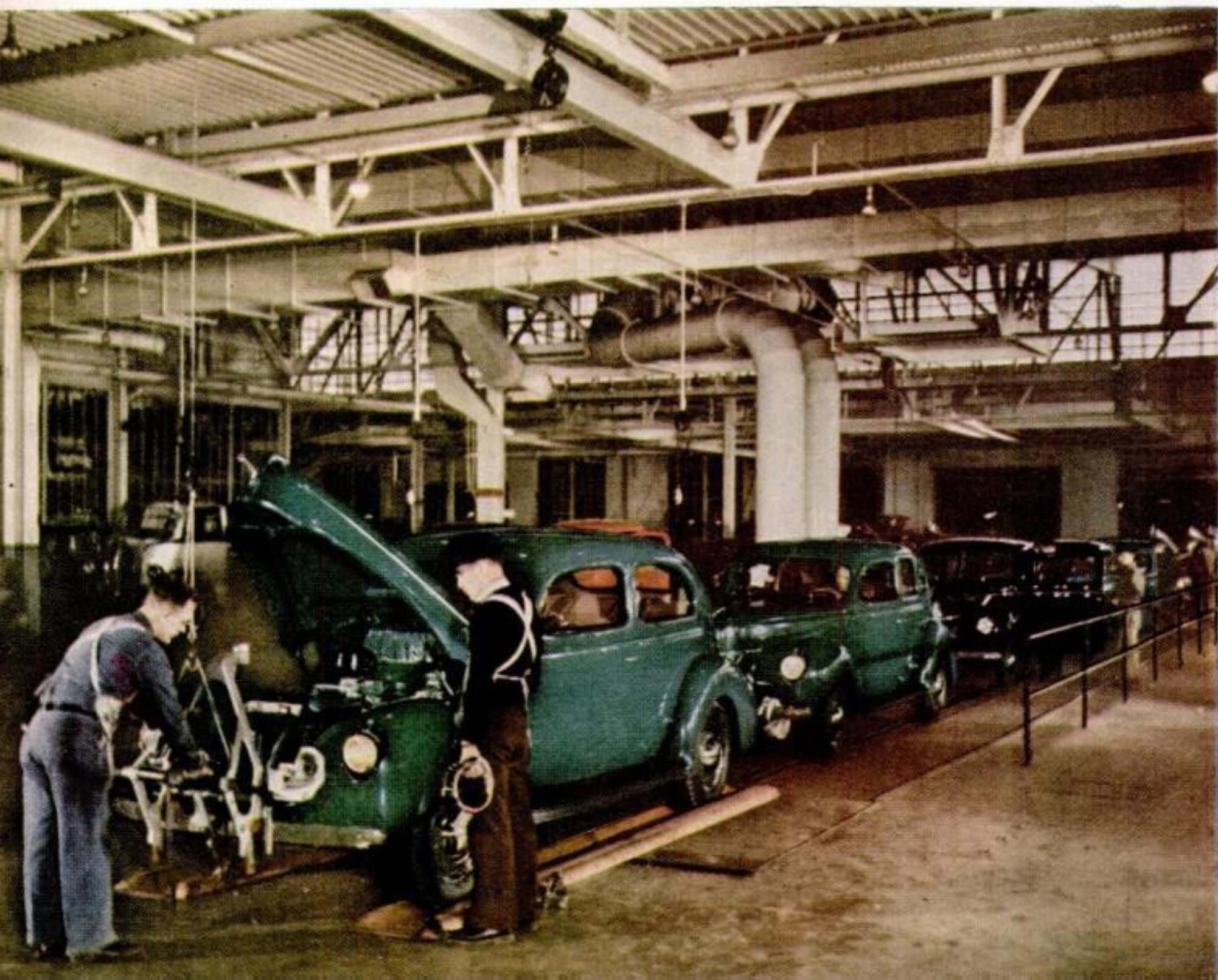
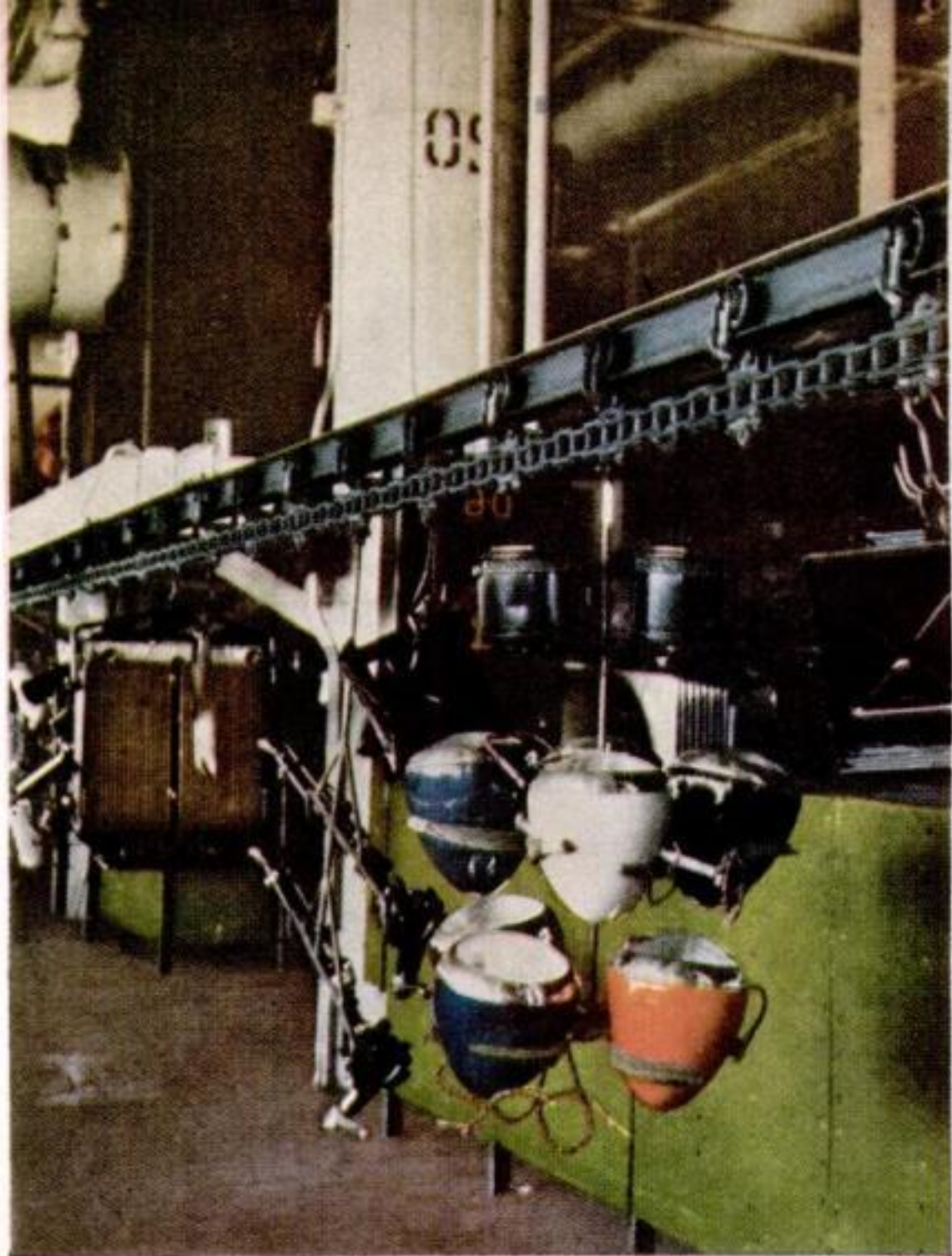
Door frames to be welded are clamped down inside this ingenious machine. A switch is thrown, and welding is done



men are assigned to the job of keeping buildings and machinery clean and safe. Each month they use around 7,000 mops, 2,700 brooms, fifteen tons of soap chips, and 32,500 gallons of paint. The Rouge plant has more than 8,000,000 square feet of floor to be scrubbed and swept!

With its 6,000 - cars - a - day capacity, the River Rouge plant is a tremendously important cog in the peacetime industrial life of the nation. And with half a world already at war, this giant factory, along with others of its kind, may become of even greater importance as a mighty factor in America's national defense, because of its ability to switch over to tanks and guns and airplanes from its normal production of trucks, tractors, and automobiles.

ASSEMBLY LINE. Conveyors like the one at the right bring finished parts to workers on the assembly lines. Below, lamps are adjusted as completed cars roll off one of the three lines, all ready for test runs and the road



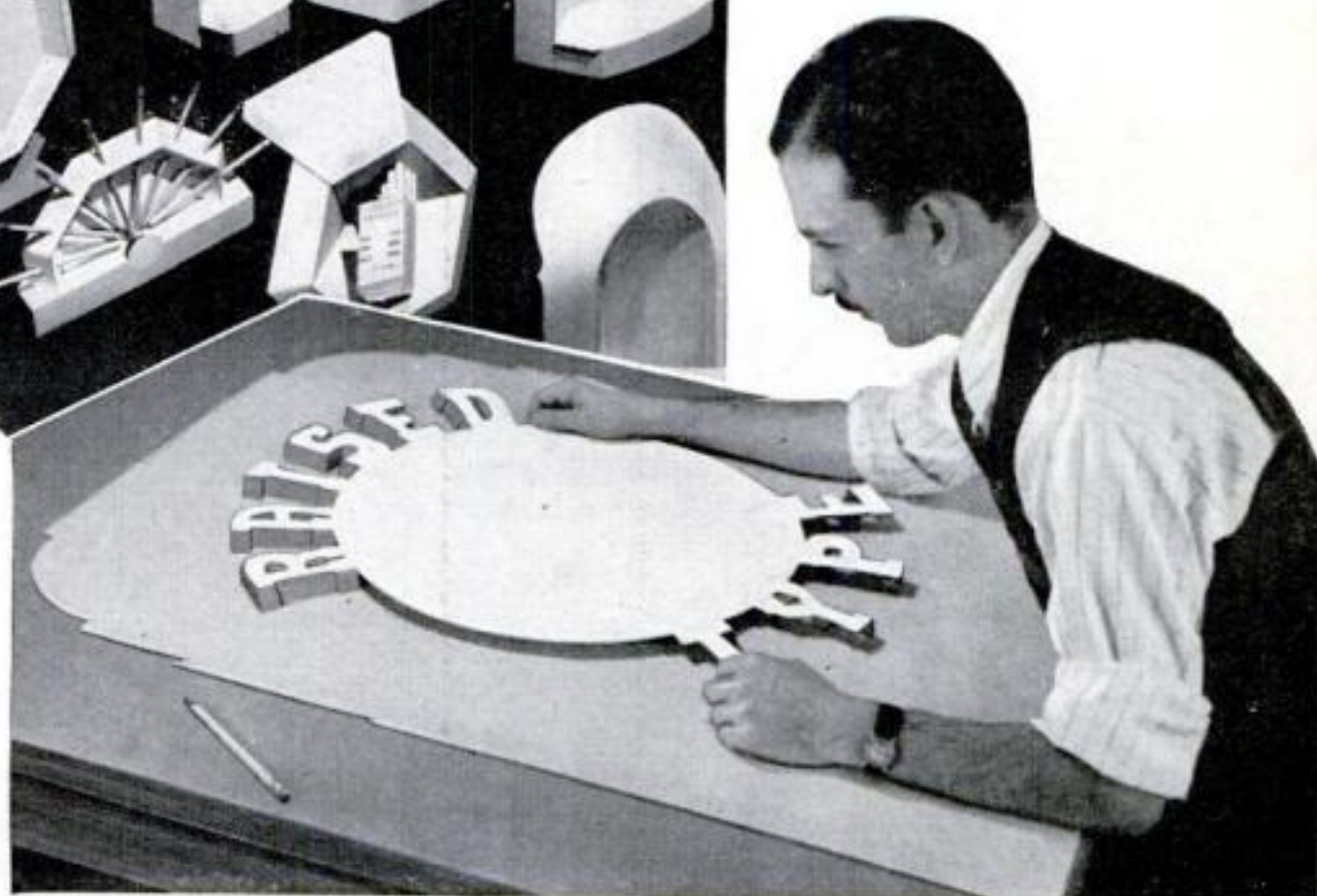
Working Wonders with Cardboard



Cardboard engineers at work. The frame in the background is designed for displaying perfume

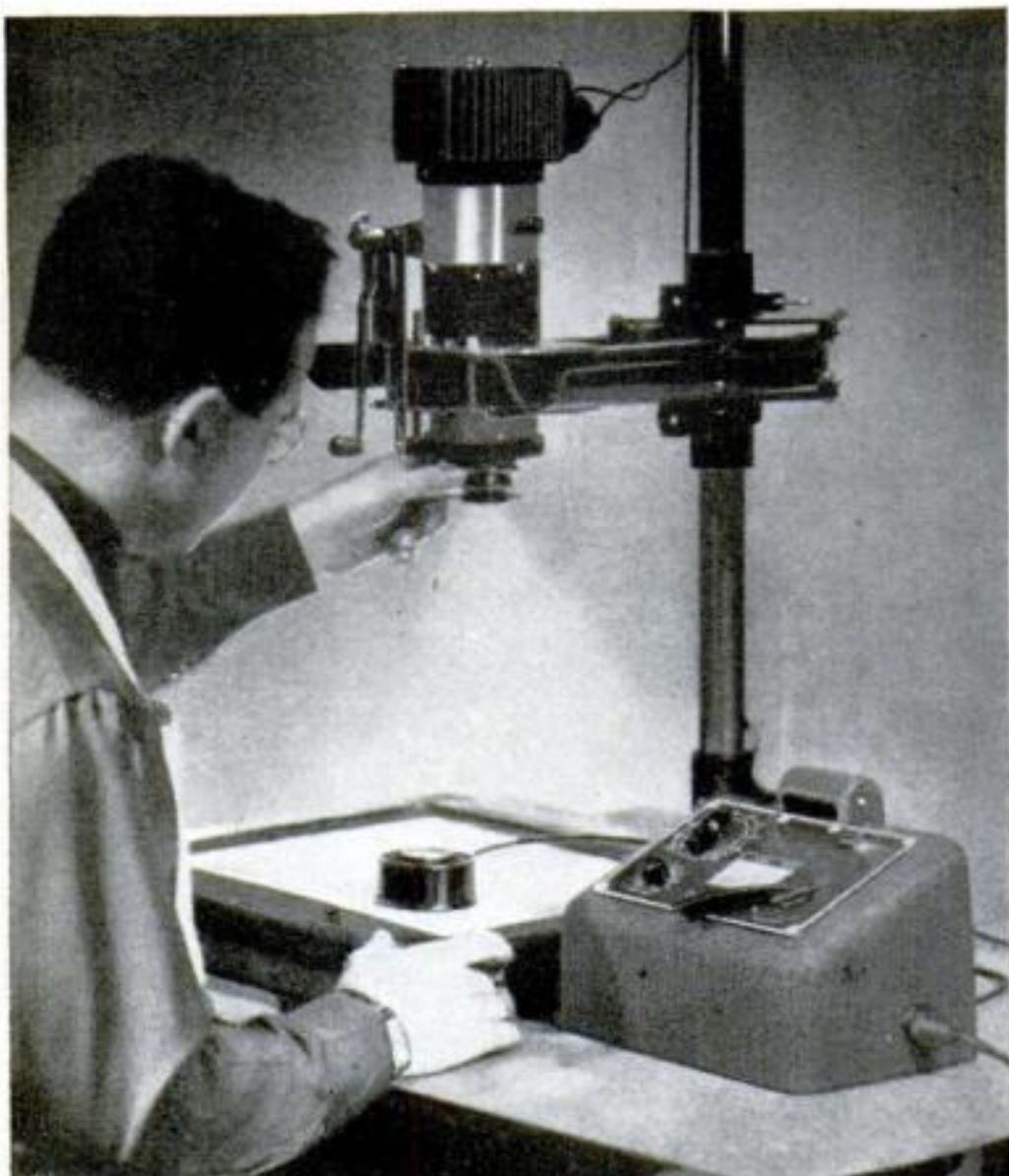


Each of the graceful shapes above is made from a flat sheet of cardboard, no paste or attachments being used. At the right, "radial folding" produces raised letters with one easy motion



COULD you fold a flat piece of cardboard, one twenty-fifth of an inch thick, so that it would support two 150-pound men? It sounds impossible, but by one of the methods developed by a Long Island City, N. Y., group of cardboard engineers, the trick is accomplished with ease. Led by Richard E. Paige, the experimenters have invented six different methods for folding flat cardboard into strong three-dimensional forms. Their discoveries have already brought about great changes in the million-dollar advertising-display industry, and are making valuable contributions to engineering practice by demonstrating the use of light, inexpensive materials that are strong because of their form rather than their bulk. Previously, cardboard had a limited range of usefulness, since it could not be folded into smooth curves, angles, and raised planes. Now, however, by geometric designing methods, a wide variety of three-dimensional forms like those at the left are easily produced.

LATEST AIDS FOR



Enlarging Meter and Timer

ENTIRELY automatic, a meter just marketed not only determines the number of seconds needed for an enlargement exposure, but also controls the exposure, shutting off the light at the proper time. No test strips are required. The device adjusts itself automatically for prints of various sizes in which the light source is nearer or farther from the paper.

Turret View Finder for Movie Camera

VIEWING the scene to be recorded with a home-movie camera equipped with three lenses mounted on a turret is simplified by the addition of a miniature turret holding a trio of viewing lenses, each showing the same area as one of the main lenses. By bringing the corresponding viewing lens into position, the area included by each taking lens is seen.



There's a viewing lens for each of three taking lenses on this home-movie camera



Album Displays Transparencies

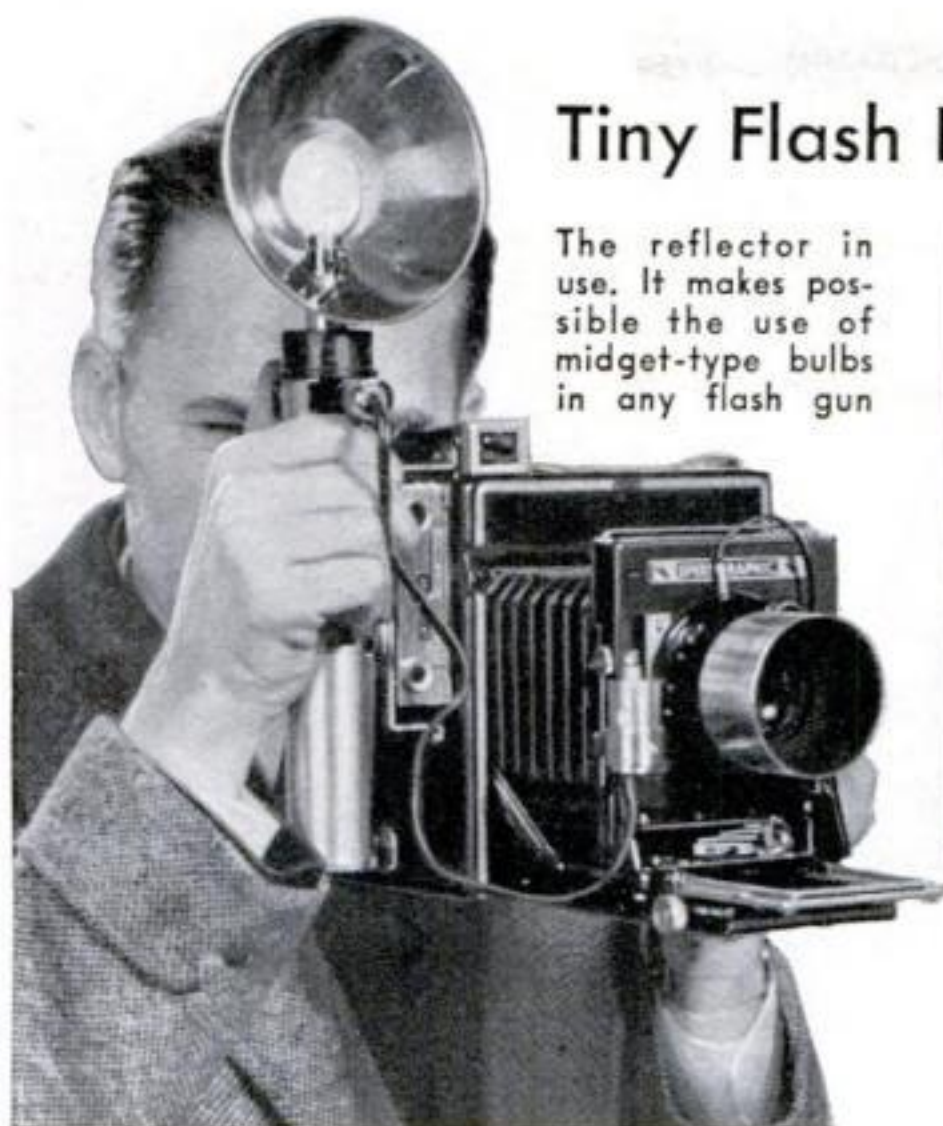
BY COMBINING the features of a slide viewer and an album, a brand-new accessory aids amateurs who make small-size color transparencies. Each page of the leather-bound, loose-leaf album accommodates eight transparencies.

With the viewer in place, a slide can be studied without removing it from the book

The viewing device, which may be stored in a pocket in the album cover, consists of three hinged sections. One forms the mirror, another a translucent window which diffuses the light, and the third a holder against which any page of transparencies can be placed for viewing without removal from the album.

CAMERA FANS

Tiny Flash Bulbs Get New Reflector



The reflector in use. It makes possible the use of midget-type bulbs in any flash gun



DESIGNED especially for use with the new midget-type photoflash bulbs, a new reflector unit serves as a flash-gun adapter. As shown in the photograph immediately at the left, the reflector is double, having a central section curved to cast a fairly concentrated spot of light. The remainder of the reflector is of the parabolic type and throws an additional pattern of light over a considerably larger area.

Extending from the base of the reflector is a neck with a standard-size plug to fit any flash-gun socket. A bayonet-type socket inside the reflector accommodates the midget "peanut" bulbs.

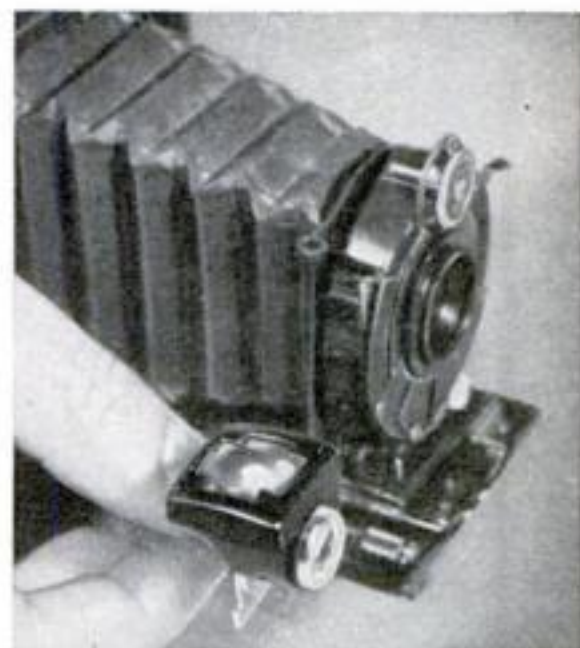
Thermometer Is Set in Hose

AS AN aid to getting exactly the right temperature in water used for photographic solutions, a thermometer has been incorporated in a rubber hose. The hose is attached to a combined hot-and-cold water faucet and the flow of water is regulated until the desired temperature is shown.



Handy Camera View Finder

WAIST-LEVEL view finders that can be slipped in place on the front support of the camera are now available for users of folding cameras equipped only with eye-level finders. The lower viewpoint is often desirable, especially in taking pictures of pets and children.



How the waist-level view finder mounts on the base of a camera

Dial Makes "Timer" of Any Clock



TURNING any clock into a darkroom timer, a new dial can be attached or removed in a few seconds. A suction cup holds it to the glass face cover of the timepiece. By setting the dial in relation to the minute or second hand, the user can determine by the dial's "stop" arrow the end of any desired exposure or development period.

New Photo Process Yields Color Prints



COLORED prints that are said to compare favorably with natural-color photographs are made possible for the amateur by a new film material invented by Jack Crawford, a New York artist. Handled like bromide paper, the film is used for making a contact print or enlargement. Then it is bleached and tanned, leaving a gelatine surface which absorbs dye in direct proportion to the exposure of the different parts of the film. After the required dyes have been applied, a white "liquid paper" is applied to its back.

Handled like bromide paper, a contact print or enlargement is made on the film



Water-soluble dyes are applied after special treatment. The dyes are absorbed in ratio to the lights and shades in the picture

Gutters for Darkroom Aprons

A **DARKROOM** apron with a trough around the bottom is a novel aid to preventing clothes and shoes from becoming stained by photographic chemicals. The trough is produced by turning up the bottom of the lightweight, rubberized apron and fastening it with metal buttons to catch stray drops of chemicals.

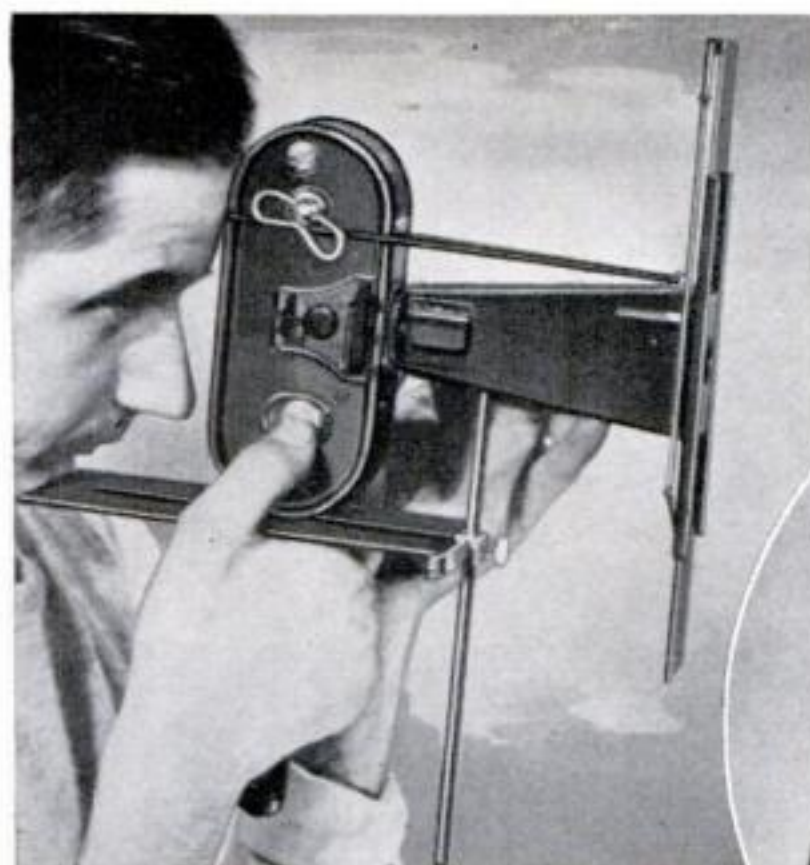


Cable Release Is Armored

ARMORED shutter-release cables, equipped with an outer covering of flexible metal, offer increased resistance to wear. With threads that fit standard shutters, the new cables are available in various lengths, even as long as 100 feet.

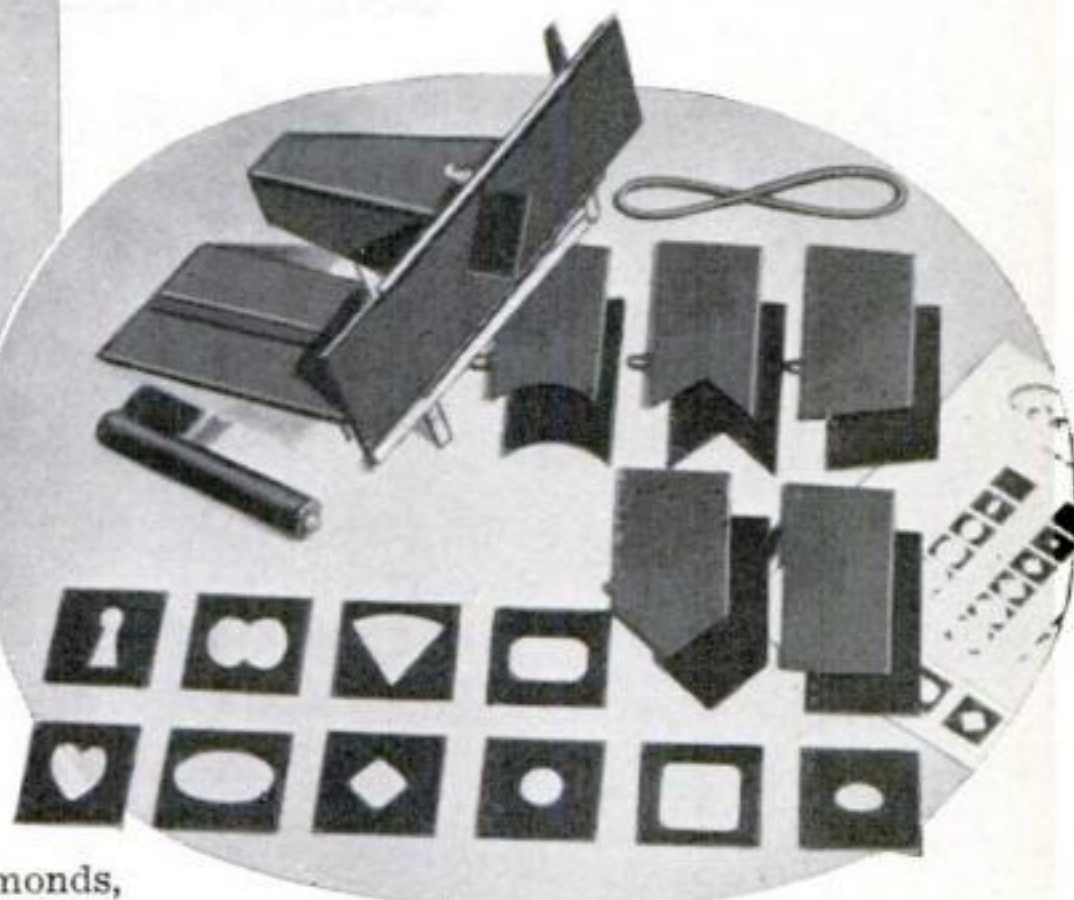


The folded-up apron edge keeps liquids from dripping onto the clothes



Scenes can be framed in almost any shape with the framing outfit at the right. The cut-out masks are inserted in the boxlike lens attachment

Framer Gives Home Movies a Professional Touch



K EYHOLES, hearts, chevrons, diamonds, and binocular lenses are some of the wide variety of framing effects for motion-picture scenes and titles obtainable with a framing unit now available. Quickly attached to any eight or sixteen-millimeter camera, the unit utilizes a light-tight metal box fitted with a vibrationproof slide in which various metal masks may be inserted.

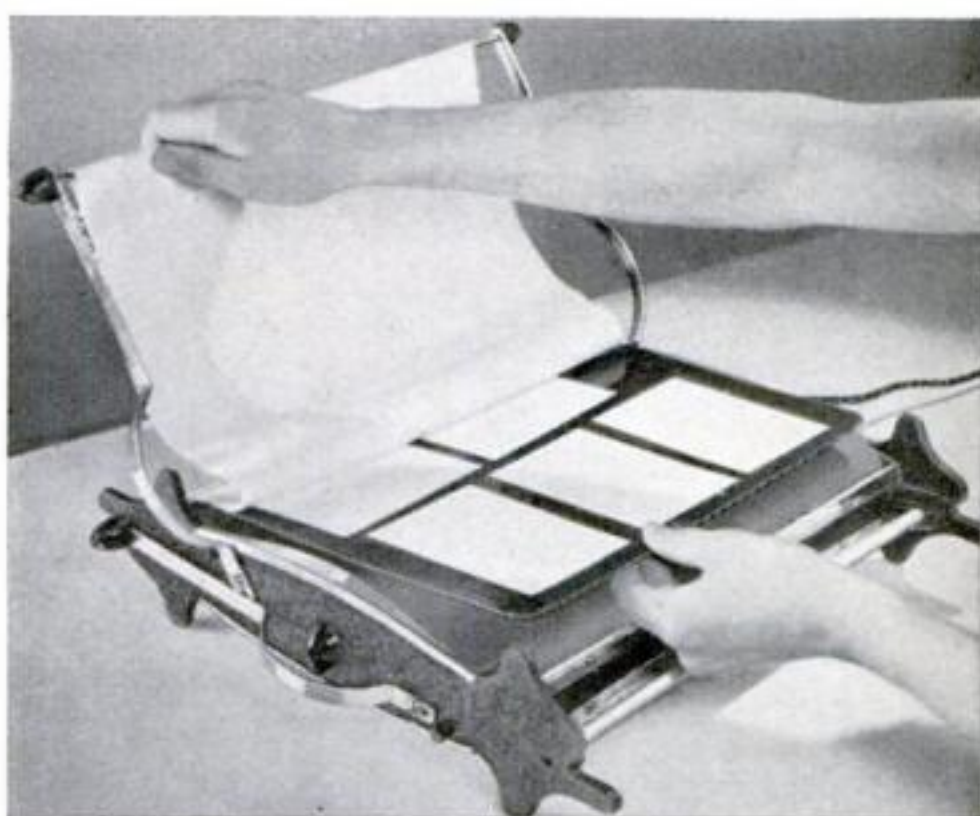
In addition, the framer is equipped with eight variable irises for obtaining novel fade-in and fade-out effects. The iris attachments are directly adjustable by means of a finger control. Light in weight, the framing unit may be used in either a vertical or a horizontal position.

Easily Applied Fluid Hardens Negatives

Now available to amateur photographers, a liquid preparation protects negatives from scratches and finger marks, keeps them pliable, and prevents them from curling. Suitable for both still and motion-picture film, the material permeates and becomes part of the emulsion, rendering it resistant to damage.



The liquid is simply wiped over the surface of the negative with a soft, lintless cloth



New Automatic Print Drier

ADJUSTABLE thermostatic control, automatic turn-off, and lintless canvas curtains are some of the outstanding features of a new electric print drier. Accommodating two ten-by-fourteen-inch ferrotype plates, the unit may also be used for mat-surface drying. The apparatus draws only 300 watts of electric current.



Suitcase Is Emergency Crib

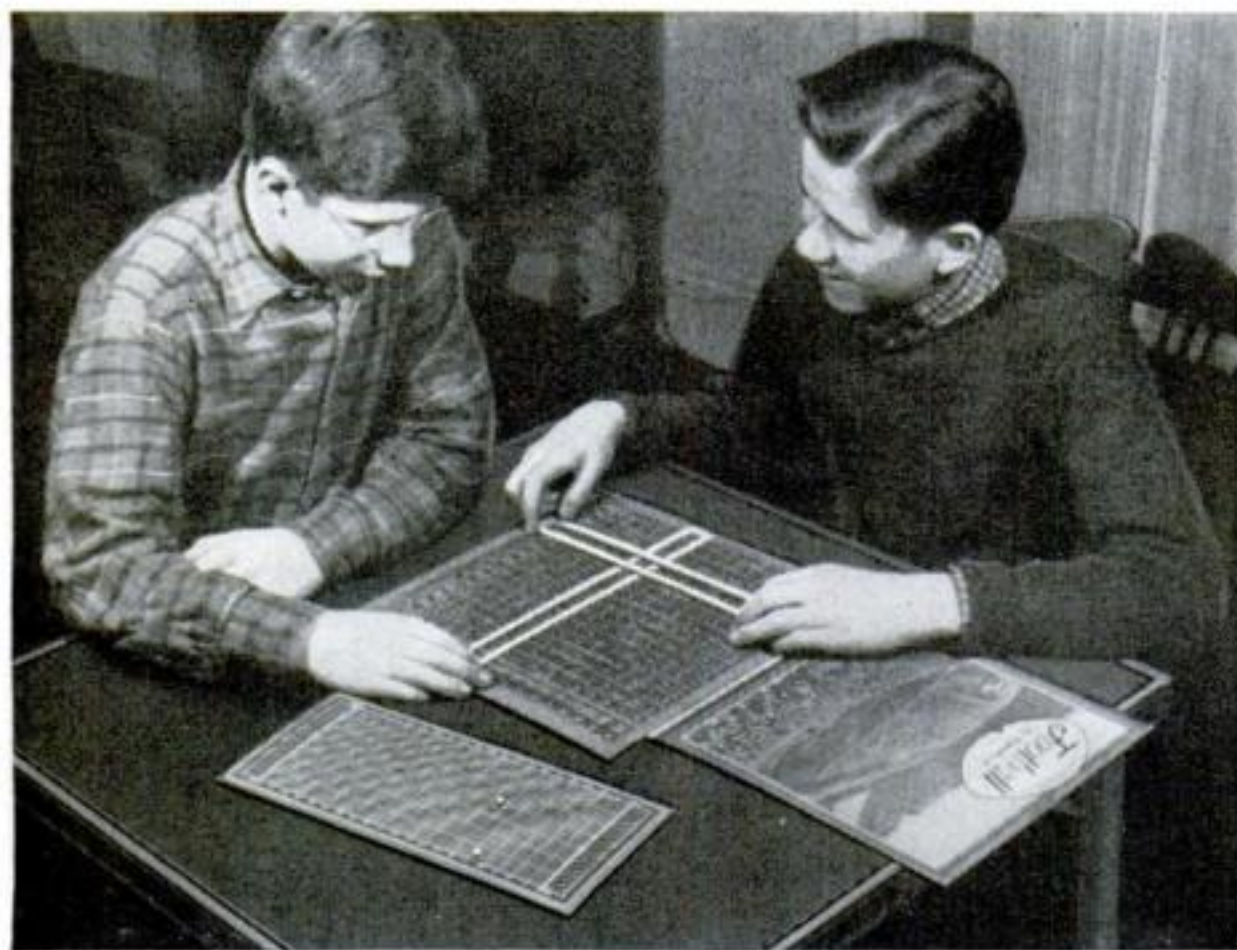
UNABLE to bring a baby's cot aboard a war-refugee ship from the Mediterranean island of Malta, an ingenious mother converted a suitcase into a combination bed and carriage for her four-month-old son. The illustration above shows them packed for the trip, with the baby watching the view through an improvised window. A lettered sign insured careful handling of the crib.

Electric Tool Cuts Door-Lock Mortises

IN A single operation requiring only a minute or so, a new electric tool cuts a complete mortise for a door lock, including recesses for both the lock barrel and face plate. Splitting the wood is declared impossible, and the work is finished forty times as quickly as by hand. Once a height rod has been adjusted, the device is self-locating.



The machine in use. It cuts a mortise for a door lock forty times faster than by hand



The game permits sixteen offense plays, and as many for the defense

Quarterbacks Match Wits at Table Football

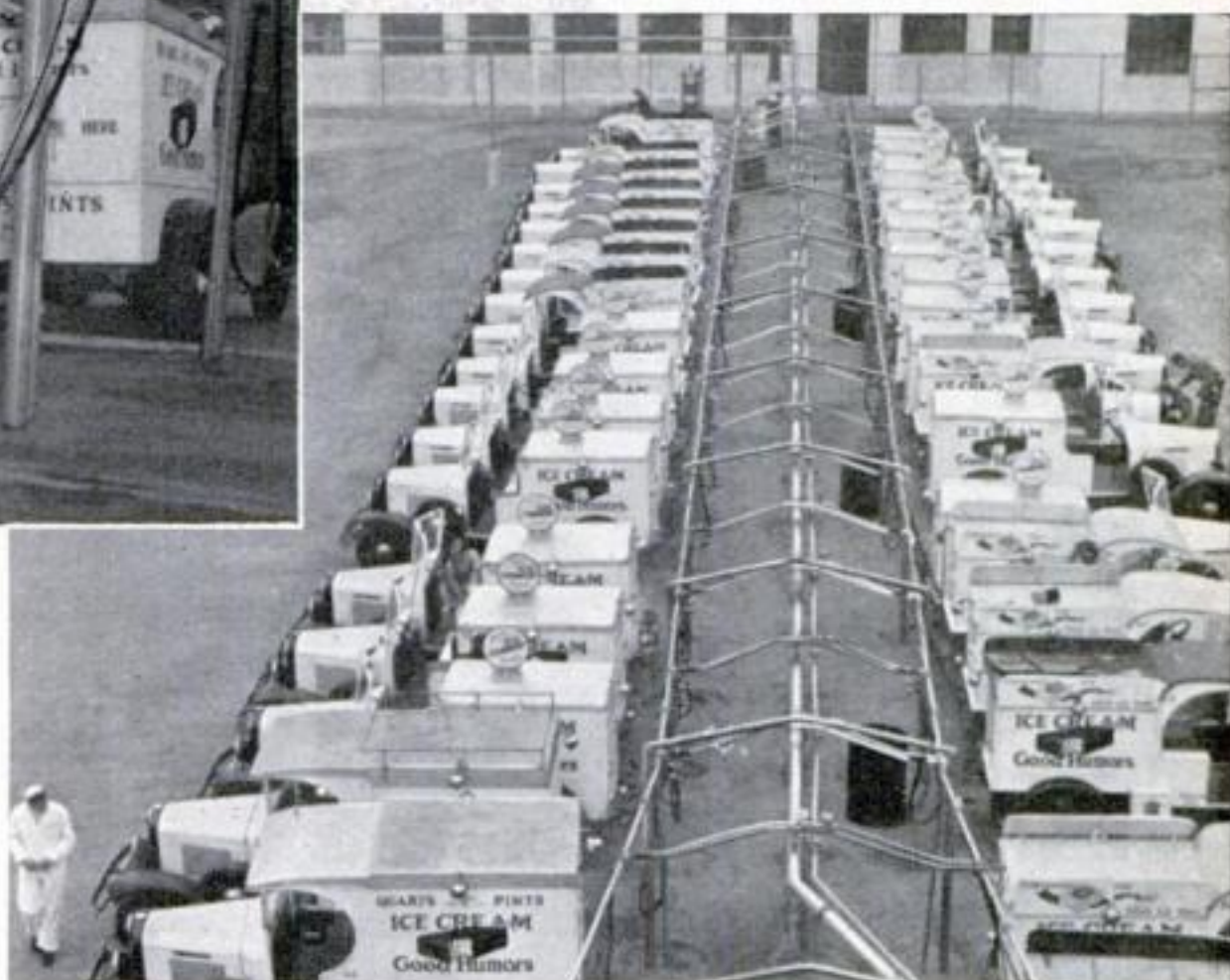
WOULD-BE quarterbacks may match wits with a new indoor football game. By moving a slide on a covered playing board, the "offense" may secretly call for any one of sixteen plays. At the same moment the "defense" moves a second slide to what he thinks the play will be. Uncovering the board reveals yardage gained or lost. Accessories keep track of the ball and the progress of the game.



By means of hoses, a refrigerant is circulated through a truck's "cold compartment"

LINED up overnight at a bank of refrigerating pipes outside a Los Angeles, Calif., ice-cream plant, dozens of trucks are cooled at once. Through pairs of rubber hoses and special couplings, the same refrigerant used in the factory circulates through each truck's "cold compartment"—a metal chamber insulated from heat by a secret compound resembling gelatin. In the

Pipes and Hoses Chill Ice-Cream Trucks



Distributing fleet lined up along the pipe line for overnight cooling

morning, a mechanic disconnects the pipes and the trucks, chilled sufficiently for all-day service, are ready to distribute the company's product.

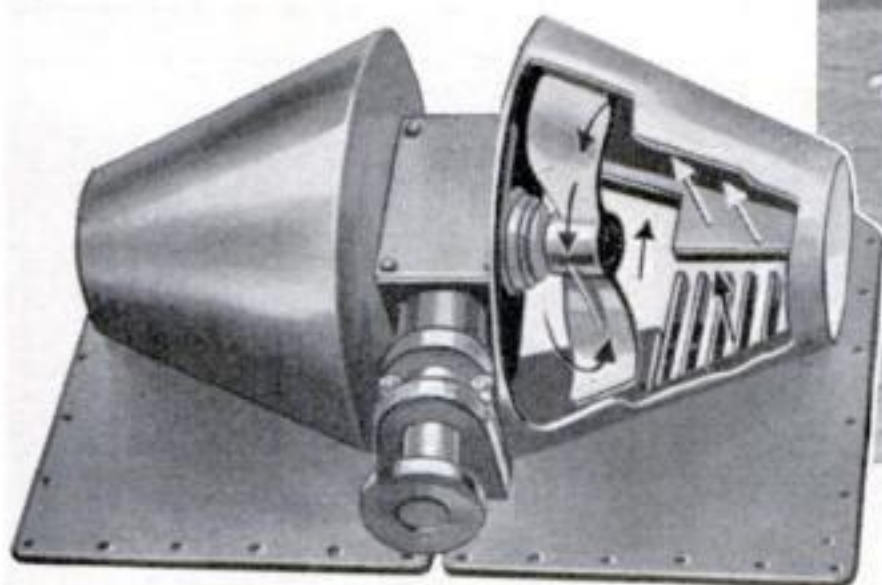
Propellerless Boat Draws Little Water

REQUIRING little more than a foot of water, a propellerless "rotorboat" has been created for a customer's Mississippi River jaunts by a veteran St. Paul, Minn., builder. Its forty-horsepower gasoline engine operates twin rotors inclosed in cones of thirty-three-inch maximum diameter. Working much like the blower part of a vacuum cleaner, the rotors draw in water and expel it through openings in the hull, propelling the boat forward or back-

ward according to which way they revolve. Intake gratings exclude weeds and debris. In trial runs, the \$10,000 cruiser has shown an average speed of fifteen miles an hour.



Thanks to the unique propelling mechanism shown in the drawing at the left, this cruiser can navigate Mississippi River waters as little as one foot deep



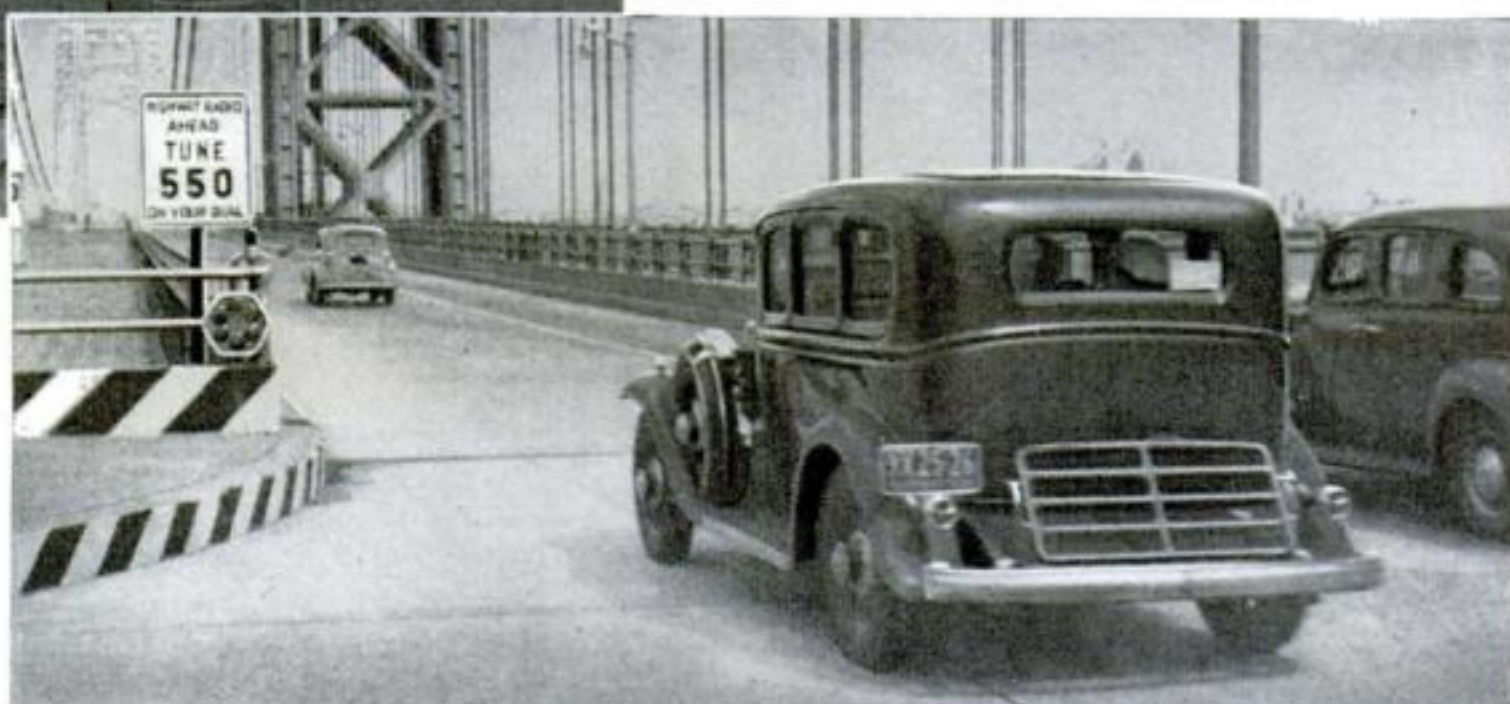
Bridge Traffic Is Controlled by Radio



DIRECTING motorists by radio has found practical application at the George Washington Bridge, linking New Jersey with New York City. At the approach to the Hudson River span, a driver sees a sign, "Highway Radio Ahead. Tune 550 on Your Dial." Setting his car radio accordingly, he listens to clear directions for negotiating the maze of exit ramps leading to different traffic arteries. The radio voice comes from an automatic curbside transmitter, by way of a wire antenna stretched the length of the bridge. As in an earlier experimental transmitter of similar design (P.S.M., Aug. '39, p. 56), a message recorded upon a magnetized steel tape is automatically repeated at regular intervals. Whenever desired, the message may be "erased" from the tape and a new one substituted. At the new George Washington Bridge installation, officials estimate, at least half of the passing motorists avail themselves of the novel service.

Recording traffic directions on a steel tape in transmitter

A sign invites motorists to tune in on the radio control



Mechanical mason at work. An electric motor whirls the trowel blades

Rotary Trowels Quickly Smooth Cement Floors

THREE rotary trowels, whirling 100 revolutions a minute in a new machine devised by a California inventor, make short work of smoothing concrete flooring and pavement. Powered by an electric motor, the 300-pound device exerts much greater pressure than can be applied by hand, permitting use of a mixture that will give a tougher and more uniform surface.

Lamp for Typists Holds Manuscript

DESK LAMP and copy holder are combined in a new convenience for typists. Wire clips hold in the light the pages to be transcribed, while the lamp shade shields the typist's eyes as seen in the photograph at the right.

Oxygen Gives Diesels a Shot in the Arm

OXYGEN fed into the intake air of a Diesel engine increases its power output by fifty-five percent for a few minutes without undue strain, according to Prof. Paul H. Schweitzer of Pennsylvania State College, who suggests that the method be used to stimulate Diesel airplane engines for the heavy load of taking off.



Clips on the lamp stand hold the pages to be transcribed

Kaleidoscope Paints Television Screen

KALEIDOSCOPE pictures have gone on the air. Just as musical selections fill interludes in sound broadcasting, the eye-pleasing patterns of light entertain "lookers-in" between television features from the National Broad-

casting Company's station W2XBS. To transform a kaleidoscope from a child's plaything into a scientific novelty of 1940, engineers first photograph a simple design upon movie film. The film then passes through a studio projector tube lined with mirrors, which multiply the design eight times to produce a symmetrical image. Two auxiliary projectors make a frame for the pictures, and superimpose any desired words or symbols upon the designs.



A kaleidoscope picture pattern as seen on the screen of the television receiver

In the studio, simple designs photographed on film are projected through a tube lined by mirrors





An adult winged cicada and the skin from which it has emerged

Return of the

Repeating Its Strange Cycle,
That Insect Rip Van Winkle,
the Periodic Cicada, Again
Enacts the Drama of Nature
That Terrified the Pilgrims
as a Plague and Omen of War

• • •

By **EDWIN TEALE**

PHOTOS BY THE AUTHOR



LOOK! BUG SHELLS! This two-year-old will be nineteen when the locusts come again. At right, a cicada crawling out of its nymphal skin, and the "W" on wing once believed to be an omen of war



Seventeen-Year Locust

JUST 306 years ago, the Pilgrim Fathers at Plymouth, Mass., were appalled at the sight of hundreds of thousands of winged and fiery-eyed creatures crawling from the ground. They mistook them for a plague of Biblical locusts and the superstitious, noticing that the letter "W" was formed by the wing veins of the insects, believed them an ominous warning of war.

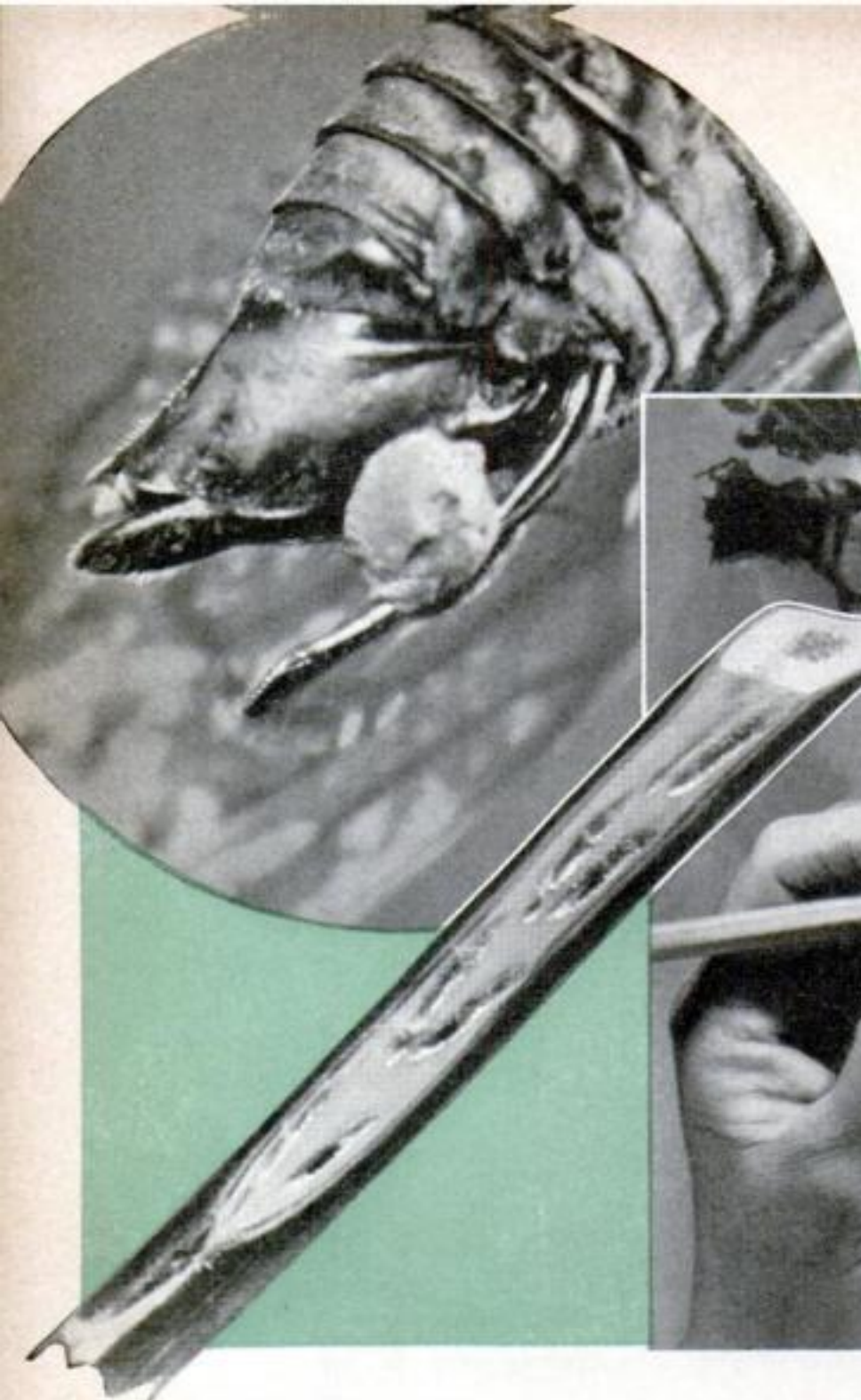
In recent weeks, descendants of these identical creatures have reappeared in Eastern woods. Once again, from Illinois to the Atlantic seaboard, from New England to Georgia, one of Nature's strangest dramas—the return of the seventeen-year locust or periodic cicada—has reached a climax. When that drama began, in 1923, Harding was president, flappers were in the headlines, radio was just rising into popularity. Like awakening Rip Van Winkles, these insects now have emerged for a few short weeks of sunshine and open air after

nearly two decades of darkness, of sucking sap from rootlets, of burrowing through the damp earth of an insect underworld.

While this brief mating season was at its height, I recently accompanied the noted cicada expert, William T. Davis, of Staten Island, N. Y., to a spot where the activity was greatest, the Half Hollow Hills region of central Long Island. Everywhere around us, heavy-bodied insects, with reddish eyes and yellow-veined wings, were fluttering among the trees. Riddling the ground at our feet were countless holes about the size of a .45 caliber bullet. In some places, they showed that the emerging insects had pushed their way up through gravel and even among small stones. Their brown, discarded skins clung to weeds, twigs, and bark, or lay in little windrows among the tree roots. Striking against the leaves, the wings of the insect hosts produced a continuous sound like falling rain. As we



This litter of empty skins indicates the vast numbers of the insects that appear at seventeen-year intervals. After their long imprisonment in the earth, they emerge for a few weeks to mate and die



LAYING EGGS. With the hard tool shown at the left, the female cicada plants her eggs in twigs. Below is a twig marked with egg slits, and another split open to reveal the eggs inside



wound, mile after mile, along country roads, a steady roar like breaking surf arose on either hand—the din of a million tiny insect drums being vibrated at once as male cicadas vied with each other in calling for mates.

This remarkable sight has been witnessed by Davis probably more often than by any other living man. In 1877, when he was a boy of fifteen, he saw it first. Today, at the age of seventy-eight, he still is a student of the cicadas. Educational institutions and museums in many parts of the world send specimens to his laboratory for study and classification. The importance of his work with cicadas has been given world-wide recognition. Of the 170 species known to the United States, he originally named and described more than 100.

AS WE moved through woods echoing with the roar of the insect multitudes, he told me something of the curious sound-producing mechanism of the males. It is a tiny drum formed of corrugated membrane, located near the base of the wing. No other insect in the world produces sound in a similar way, and only the males possess the drums. The females are silent. Davis has seen the females alight near the drumming males, seemingly attracted by the sound. He has also seen other males descend beside such soloists and, in evident displeasure and

jealous rage, butt their rivals like goats!

A curious thing in connection with the effect of certain sounds on cicadas was observed a few years ago by a scientist in Kansas. He noticed that the insects alighted in large numbers on tractors used in plowing. The drumming of the engines apparently attracted them to the machines.

Some relatives of our seventeen-year cicada, Davis told me, use their drums to produce strange and alarming sound effects. In the West, for example, there is a dark, smoky-winged insect that gives an almost exact imitation of the rattle of a rattlesnake. Collectors always have to be on their guard. Many times they have peered into a bush from which they thought a cicada was calling, and have found instead a coiled and buzzing snake.

Among the vast array of specimens, neatly pinned in wooden boxes that stand row on row in Davis's Staten Island laboratory, are most of the strange cicadas of the world. There is the biggest known, an insect from Borneo with a seven-inch wing spread and a body far larger than that of a humming bird. There is also the tiniest cicada, a midget hardly half an inch long, from Texas. There are "stop-and-go" cicadas, beautiful creatures from the rainy side of the Andes, so called because they have bright red spots on the hind wings

and bright green ones on the fore wings. There is one species with a jet-black body and a strawberry-red nose and another which is bright green and known locally in Australia as the "Green Monday." Probably the most curious of all the specimens is an Australian cicada with a hollow, balloon-like abdomen which acts as a sounding board to amplify the noise of the tiny drums.

Several of the insects among the seventeen-year cicadas and their relatives in Davis's collection were obtained under rather unusual circumstances. There is one grayish-brown desert cicada, for instance, which has been found only in automobiles. The first two specimens to come to the attention of science—one arriving at Davis's laboratory and the other at Oxford University, England—were both discovered in motor cars after tourists had driven through desert country in western states.

In another case, a friend of Davis's was traveling in a remote island of the Caribbean Sea when he heard cicadas in a wood-

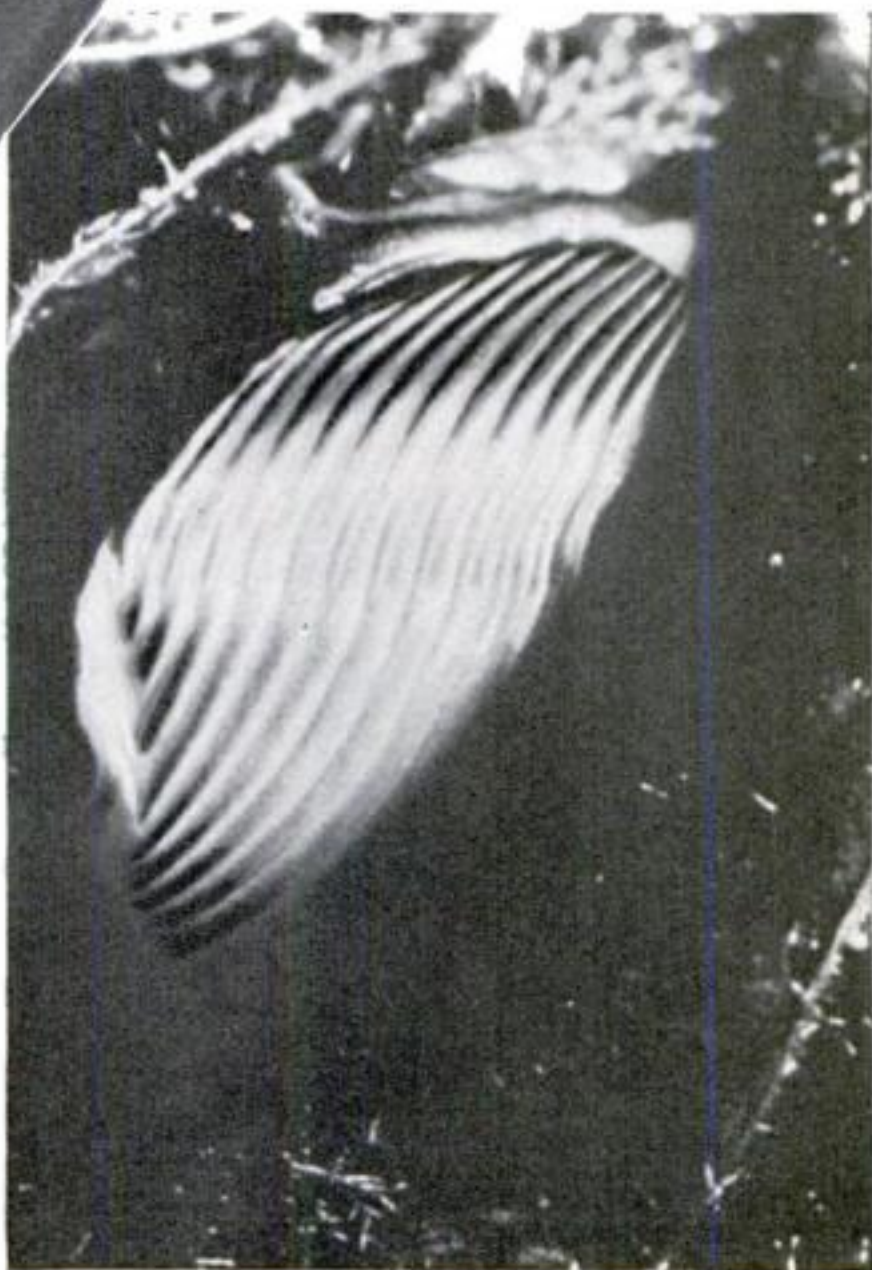
land. He made arrangements with a local taxi man to collect some of the insects and send them to Davis. The man did such a good job that Davis showed his appreciation by naming one of the cicadas in his honor and publishing an account of it in a scientific bulletin. Immediately afterwards, the taxi man disappeared. It developed that he was a fugitive from justice who had considered himself safe on the out-of-the-way island. Then, by capturing a bug, he had thrust himself into the limelight!

While many of the 2,000 different species of cicadas known to entomology have strange shapes and even stranger habits, the most celebrated is still the "seventeen-year locust" of our Eastern States. As we watched the great hosts of these creatures in the woods of the Half Hollow Hills, Davis told me a few of the "it-isn't-so's" about them. In the first place, they are not locusts, but an entirely different kind of insect. The Pilgrim Fathers called them locusts and the name has stuck in spite of entomology. Again, the statement, found in many texts, that periodic cicadas—like tobacco and wild turkeys—are native only to North America, has been proved untrue. *(Continued on page 232)*



Locust and discarded skin. The red eyes of the periodic cicada distinguish it from its insect relatives

This is the drum of corrugated membrane with which the male cicada produces its mating call. It is located under the abdomen





Here's My Story

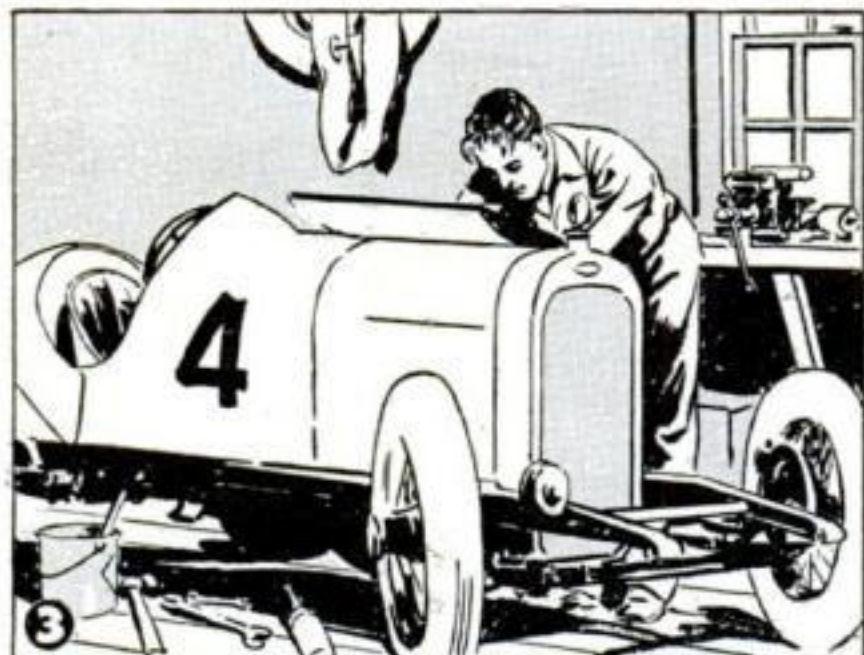
EDWARD V. RICKENBACKER WAS BORN IN COLUMBUS, OHIO, OCT. 8, 1890



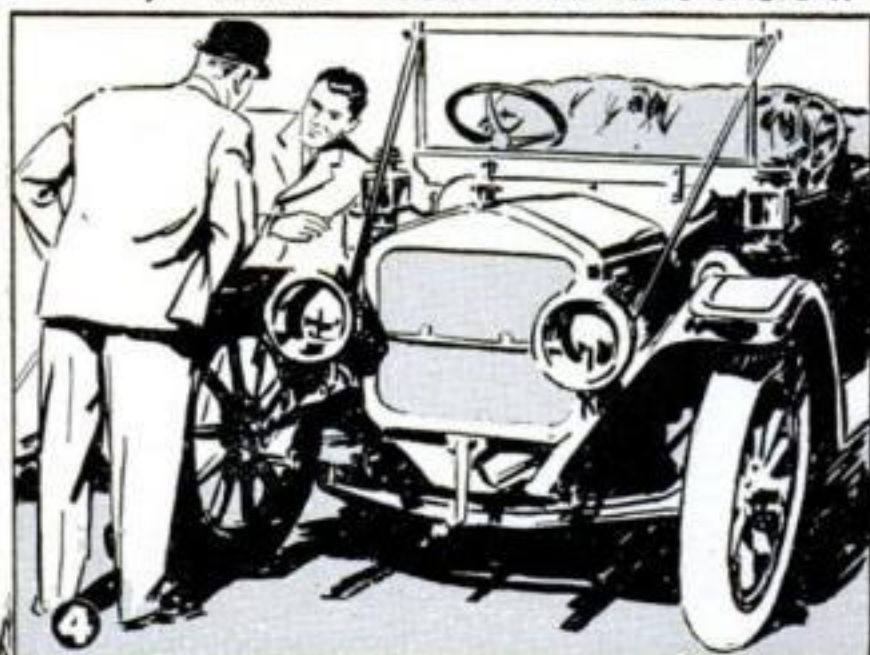
1 AFTER HIS FATHER DIED, 12-YEAR-OLD EDDIE, CLAIMING HE WAS 14, GOT A NIGHT JOB IN A GLASS FACTORY. HE WORKED 12 HOURS A NIGHT FOR \$3.50 A WEEK



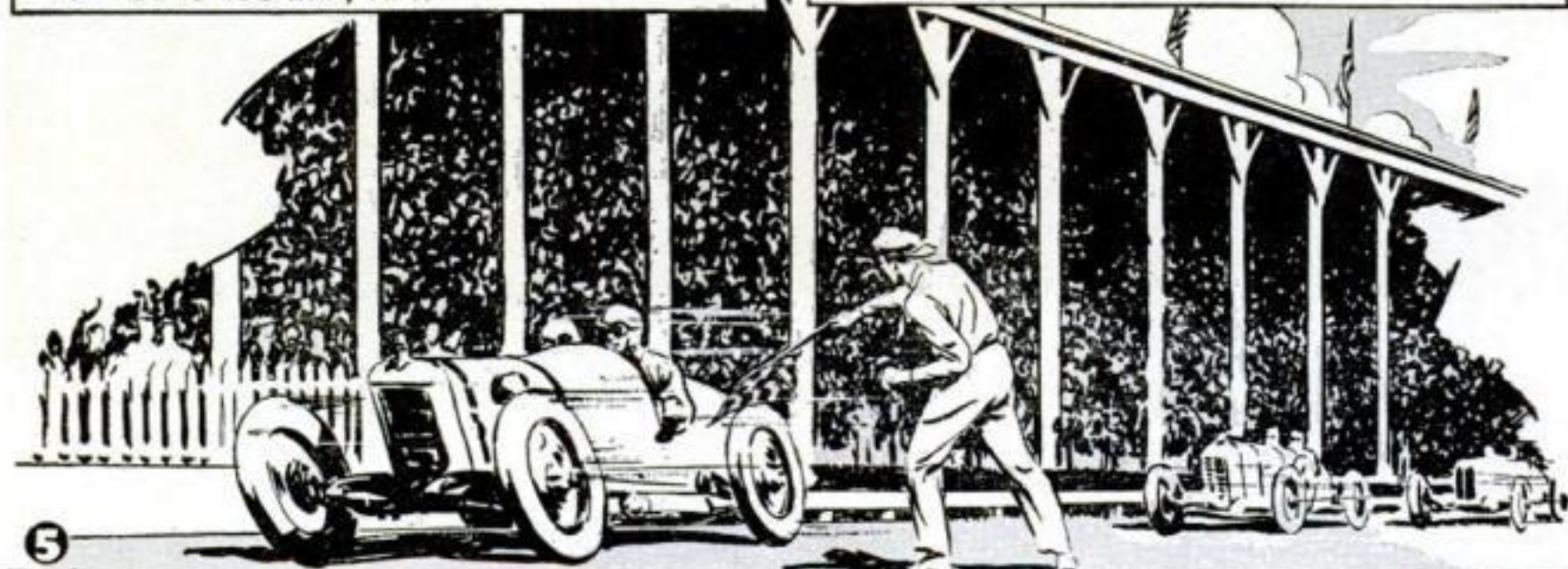
2 LATER, DECIDING TO BECOME AN ENGINEER, HE WENT TO NIGHT SCHOOL AND TOOK CORRESPONDENCE-SCHOOL COURSES. FASCINATED BY AUTOMOBILES, HE STARTED WORK WITHOUT SALARY, SWEEPING FLOORS IN AN AUTO FACTORY



3 EDDIE SOON WORKED HIS WAY UP TO THE POST OF PERSONAL MECHANIC AND RACING ASSISTANT TO HIS BOSS, LEE FRAYER, WITH WHOM HE RODE IN VANDERBILT CUP RACES ON LONG ISLAND, N.Y.



4 SHORTLY AFTERWARD, HE BECAME AN AUTOMOBILE SALESMAN. BECAUSE SPEED SOLD CARS IN THOSE DAYS, RICK ENTERED ALL THE COUNTY-FAIR AUTO RACES HE COULD



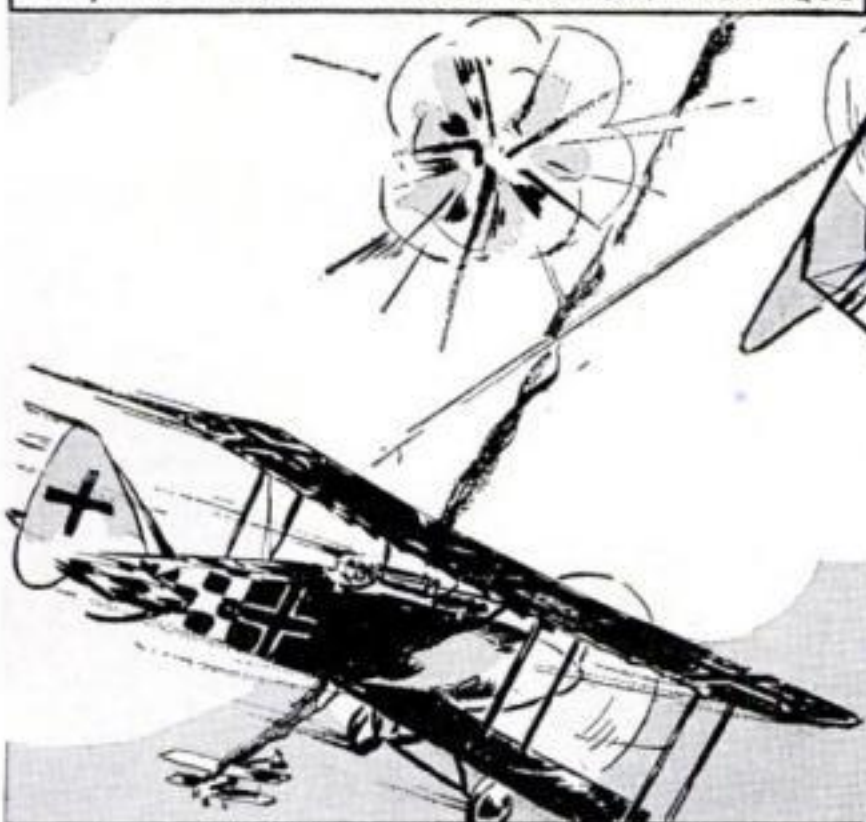
5 IN 1912, HE QUIT HIS JOB TO CONCENTRATE ON AUTOMOBILE RACING. SOON HE WAS NATIONALLY FAMOUS AS A SPEED DEMON AT THE INDIANAPOLIS SPEEDWAY AND OTHER TRACKS

THE CAREER OF CAPT. EDDIE RICKENBACKER



6

WHEN THE U.S. ENTERED THE FIRST WORLD WAR, RICK WENT TO FRANCE AS CHAUFFEUR TO GENERAL PERSHING. HE SOON TRANSFERRED TO THE AIR CORPS, LEARNED TO FLY, AND TAUGHT HIMSELF COMBAT TECHNIQUE



7

RICKENBACKER BECAME COMMANDER OF THE FAMOUS AMERICAN "HAT-IN-THE-RING" SQUADRON, AND WON HONORS AS AMERICA'S GREATEST ACE, SHOOTING DOWN 26 ENEMY PLANES. ONCE, FLYING ALONE, HE ATTACKED SEVEN GERMAN PLANES, DOWNED TWO, AND RETURNED TO HIS BASE UNSCATHED



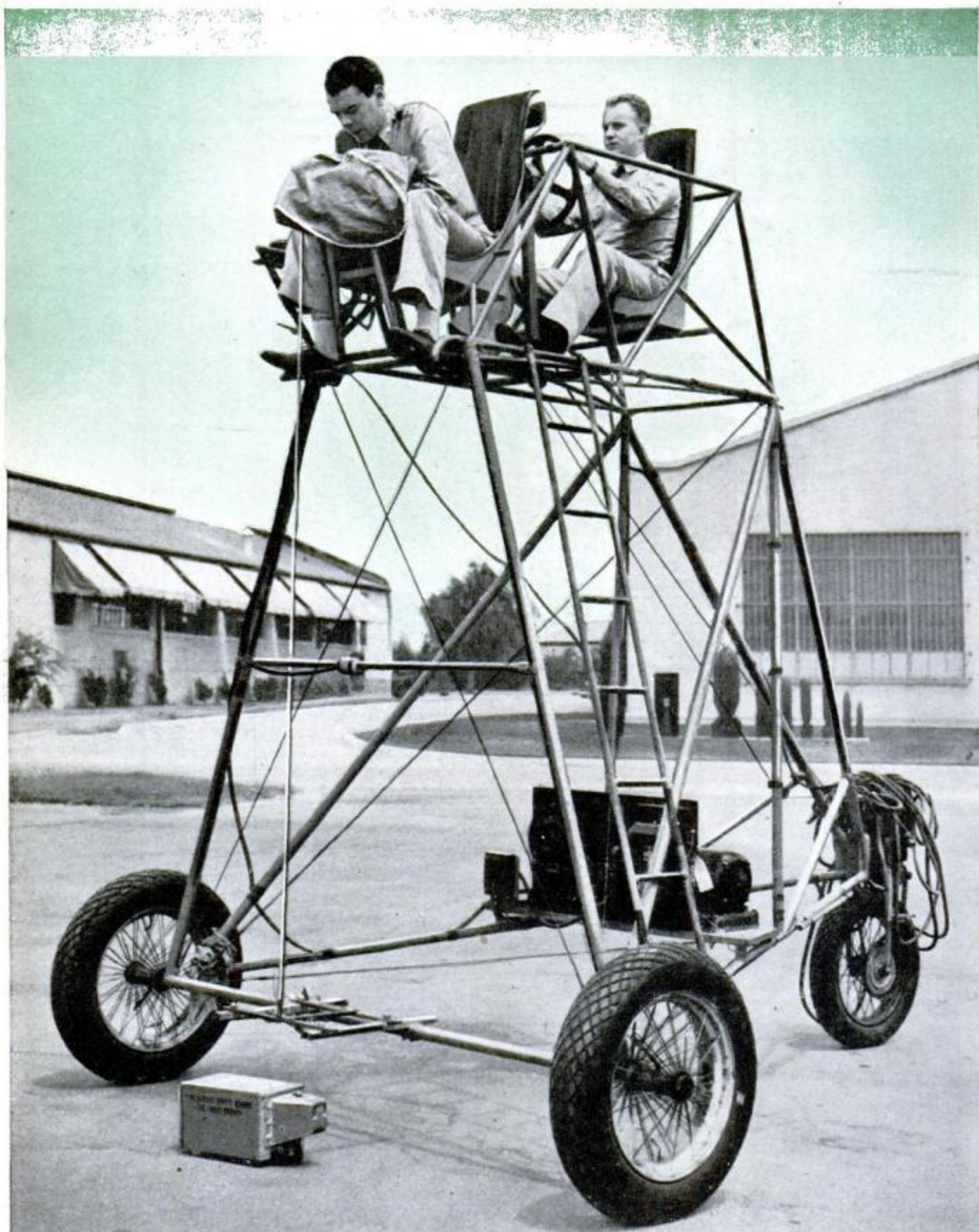
8

WELCOMED HOME AS A NATIONAL HERO, HE ORGANIZED THE RICKENBACKER MOTOR CO. HE THEN WORKED FOR CADILLAC AS ASSISTANT SALES MANAGER OF THE LA SALLE DIVISION



9

LATER, RICK SWITCHED FROM THE AUTO TO THE AVIATION INDUSTRY. HE NOW HEADS EASTERN AIRLINES AND THE INDIANAPOLIS MOTOR SPEEDWAY



"Tricycle" Trains Army Bombers

PERCHED on an odd three-wheeled framework of metal tubing, a U. S. Army pilot and his bombardier are pictured above at Riverside, Calif., getting in some ground bombing practice with an electrical machine said to simulate actual bombing con-

ditions. A falling plumb bob plays the rôle of a bomb. Note that the bomb sight, a closely-guarded Air Corps secret since it is reputed to be the most accurate in the world, is covered with a hood to hide it from the prying eye of the camera.



Joseph Rostick, right, consulting his pilot before a flight

Flying Dock Master Spots Ships by Air

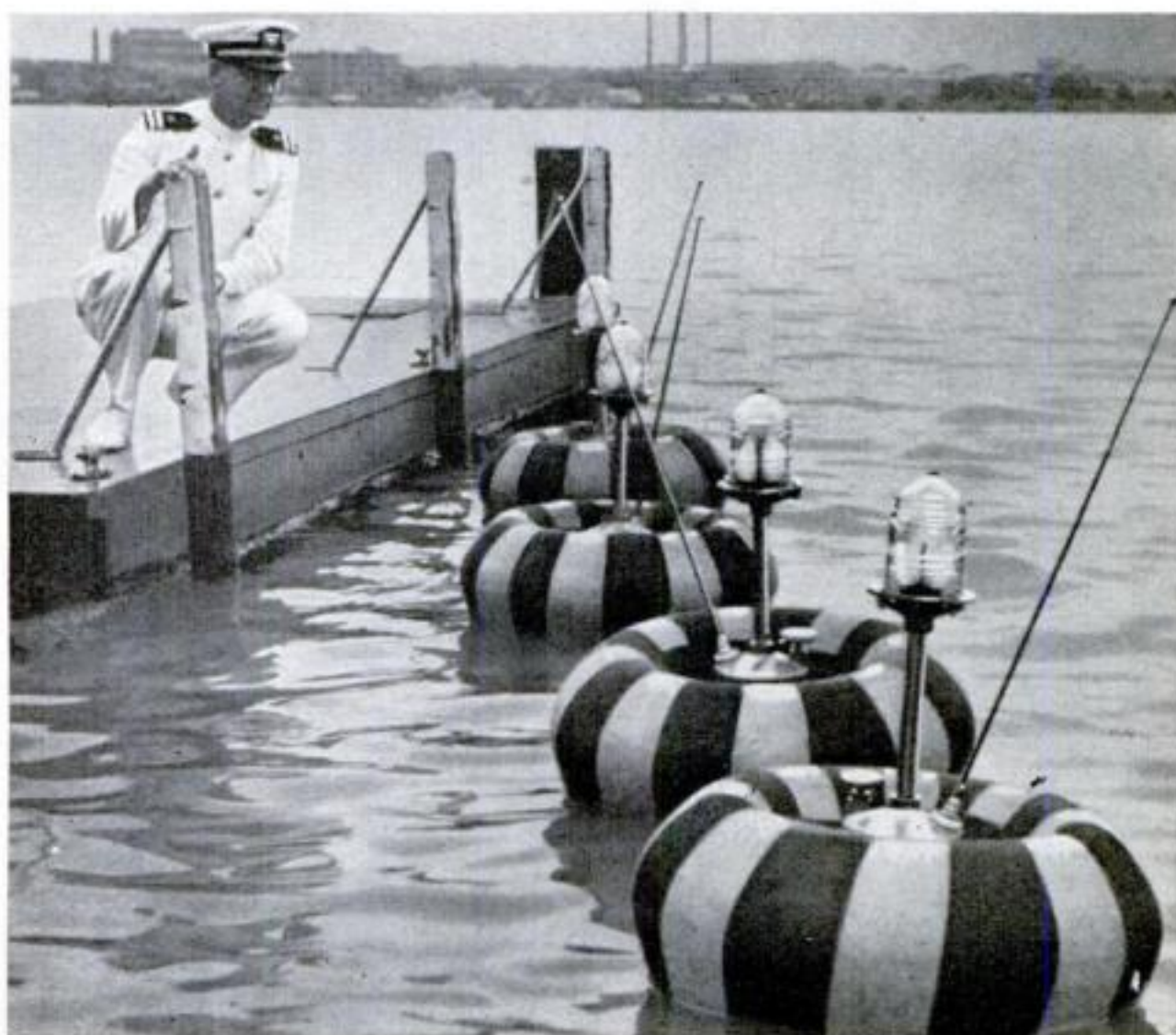
COVERING his "beat" by air saves untold time and trouble for Joseph Rostick, New York dock master, whose duty is to collect wharfage fees from transient boats using city-owned facilities. Piloted in a light plane along miles of waterfront, he readily spots new arrivals tied up at the piers. Thus he finds out just where to pay his calls when he gets back to earth without wasting time hunting his "customers."

Quinine Cures Fever in Airplanes, Too

QUININE, long a medical standby for combating high fevers, has a similar value in aviation, according to researches made recently in the laboratories of the Standard Oil Company at Cleveland, Ohio. It was found that small quantities of the drug added to lubricating oil keep the oil from decomposing at the high temperatures produced in airplane engines.

Radio Controls Seaplane Landing Buoys

TURNED on and off by radio control, new lamps on air-filled rubber floats will outline safe landing lanes for aircraft in U. S. harbors. Green lights mark the entrance to the aquatic runway, yellow lights are spaced along its 5,000-foot length, and red lights show its end. Powered by dry cells, the lamps are of the new fluorescent type in which glowing chemicals provide the illumination. Their doughnut-shaped floats bear black and yellow stripes for daytime visibility. The softly inflated floats are no hazard to water craft, and tests have shown that they are not easily damaged by collisions.



Floating markers for seaplane landing lanes. Note radio-control antennas

HOW AIRLINE



SCUDDING across a broad black runway at the world's largest airport, in New York City, an American Airlines transport wings into the air on a 1,000-mile non-stop flight. Up in the cockpit, a seasoned transport captain, veteran of hundreds of aerial voyages, guides the plane westward. Beside him, his assistant, called

First Officer Hatch pulls in the flag. Below, he is seen with his fellow-students Dugan and McCormick, arriving at LaGuardia Field for training



Edwin Harley Hatch

THREE typical airline pilots—one from the U. S. Army, one an experienced commercial pilot, and the third from the U. S. Navy.

EDWIN HATCH came to the airline school from the Army Air Corps. After graduating from the Advanced Flying School at Kelly Field, Tex., in 1939 he remained in the Army until January, 1940.

WHEN he was a junior in high school, W. W. McCormick learned to fly. In 1933 he was selected to accompany Admiral Richard E. Byrd to Little America



W. W. McCormick

as an autogiro pilot. On his return, he served as a flying instructor and after 2,000 hours of commercial flying decided to enter training as an airline pilot.

BORN in Memphis, Tenn., in 1914, Edward Dugan joined the U. S. Navy in 1935. He received flight training at Miami and at the Pensacola, Fla., Naval Air Station and then served on the *Pensacola* and the aircraft carrier *Ranger*. He entered the pilot school in January, 1940.



Edward J. Dugan

CAPTAINS ARE MADE

the first officer, is off on his initial flight as a member of the plane crew, starting a transport career that will lead him to a \$9,000-a-year job as captain of a flying flagship.

What does it take to make an airline captain? How does a candidate qualify for the job? How is he trained for a post where he will be entrusted with the air safety of twenty-one passengers and a \$120,000 plane?

American Airlines selects its pilots, at a rate now approaching one a day, from three main sources: commercial, military, and naval aviation. A prospective first officer must have a commercial license with at least 1,000 hours of flying, or its equivalent in Army or Navy air experience. He must be a citizen of the United States, and not more than thirty-two. He must have perfect health, a pleasing personality, and a real love for the job.

Of the three budding first officers whose training



1



2

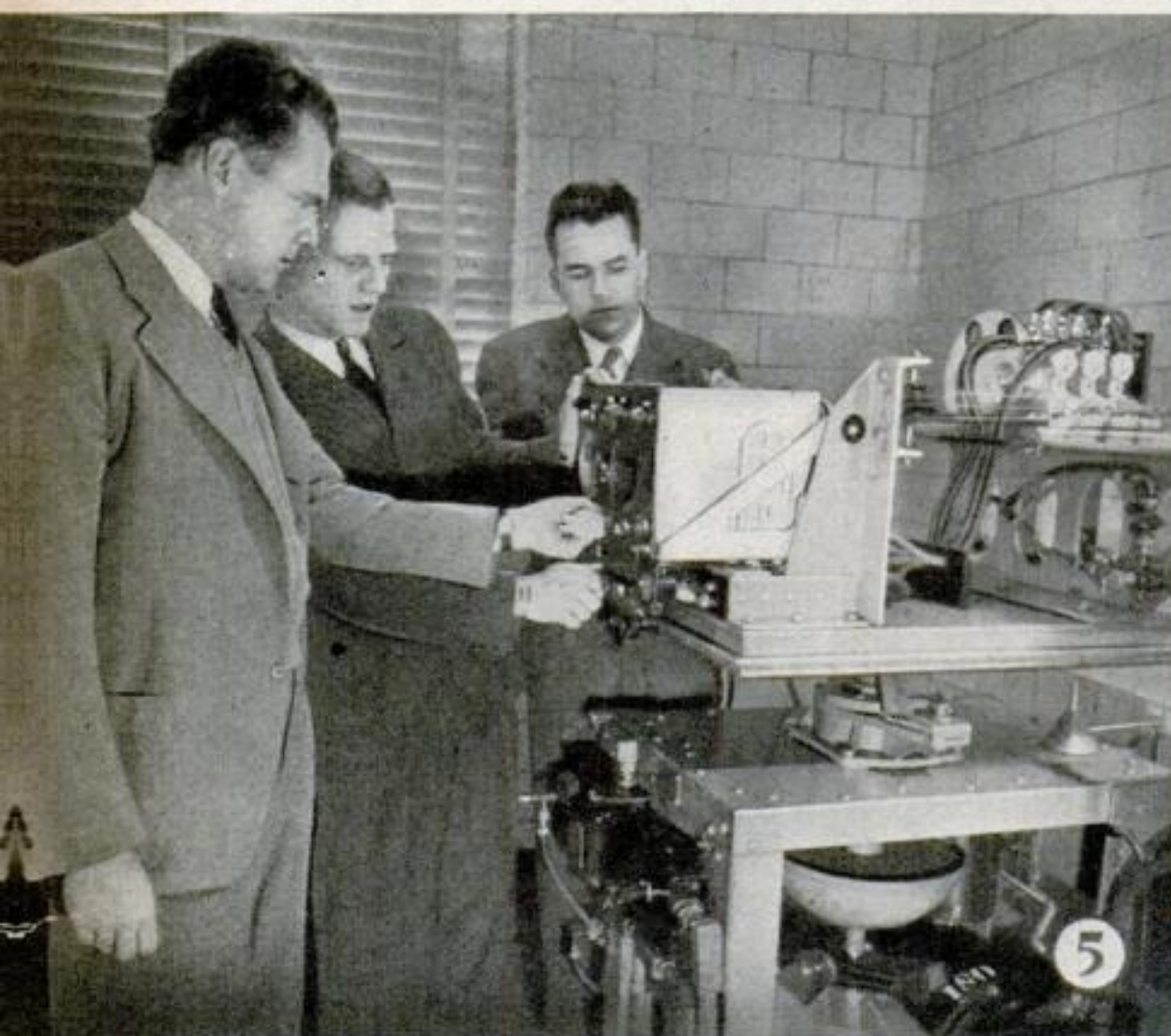
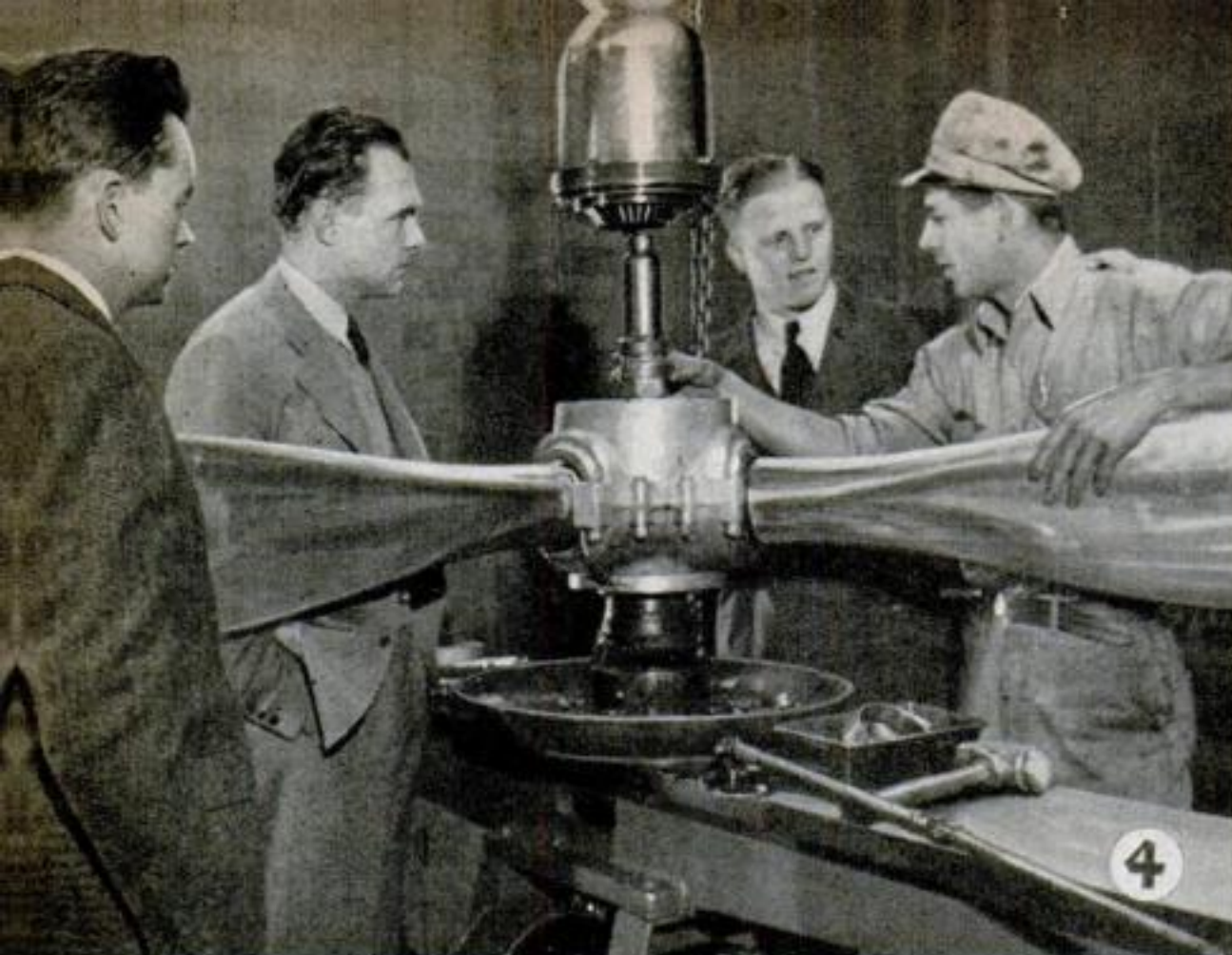
1 Newly arrived, the training-classmen take a look at one of the big flagships they soon hope to be able to fly. An instructor is pointing to a direction-finding antenna

2 Old-fashioned classroom examinations reveal the would-be pilots' technical knowledge of flying. In the background is the Link trainer used in blind-flying tests

3 Accepted for enrollment, the three students draw their books for study. The stacks of manuals and instruction sheets will require many hours of burning midnight oil



3



career is followed in the accompanying photographs, one came from the Army Air Corps, one from duty aboard a Navy aircraft carrier, and one from commercial flying on the Pacific coast. All three passed their physical examinations with flying colors, and started their training together in American Airlines' pilot-training school in Hangar 1 at the airline headquarters, LaGuardia Field, New York City.

Because the trio, like all other candidates for flagship berths, were already accomplished flyers, their training was designed primarily to familiarize them with airline procedures and the handling of the giant twelve-ton Douglas twin-motor transport planes. Their first schooling consisted of a series of lectures given by veteran pilots and specialists on subjects that ranged from meteorology, radio, and navigation, to civil air regulations and general airline operations.

By observation and actual work in the huge maintenance and repair shops of the airline, they learned about the operation and upkeep of all parts of their planes—hydraulic landing gear, batteries, fuel, heating and venti-

4 Practical knowledge is quite as important as theory. Here Dugan, McCormick, and Hatch are being shown the workings of the controllable-pitch propeller by an American Airlines mechanic

5 On a tour through the shops at LaGuardia Field, the trio of young pilots examines a plane radio receiver being overhauled. They familiarize themselves with the ground-service organization

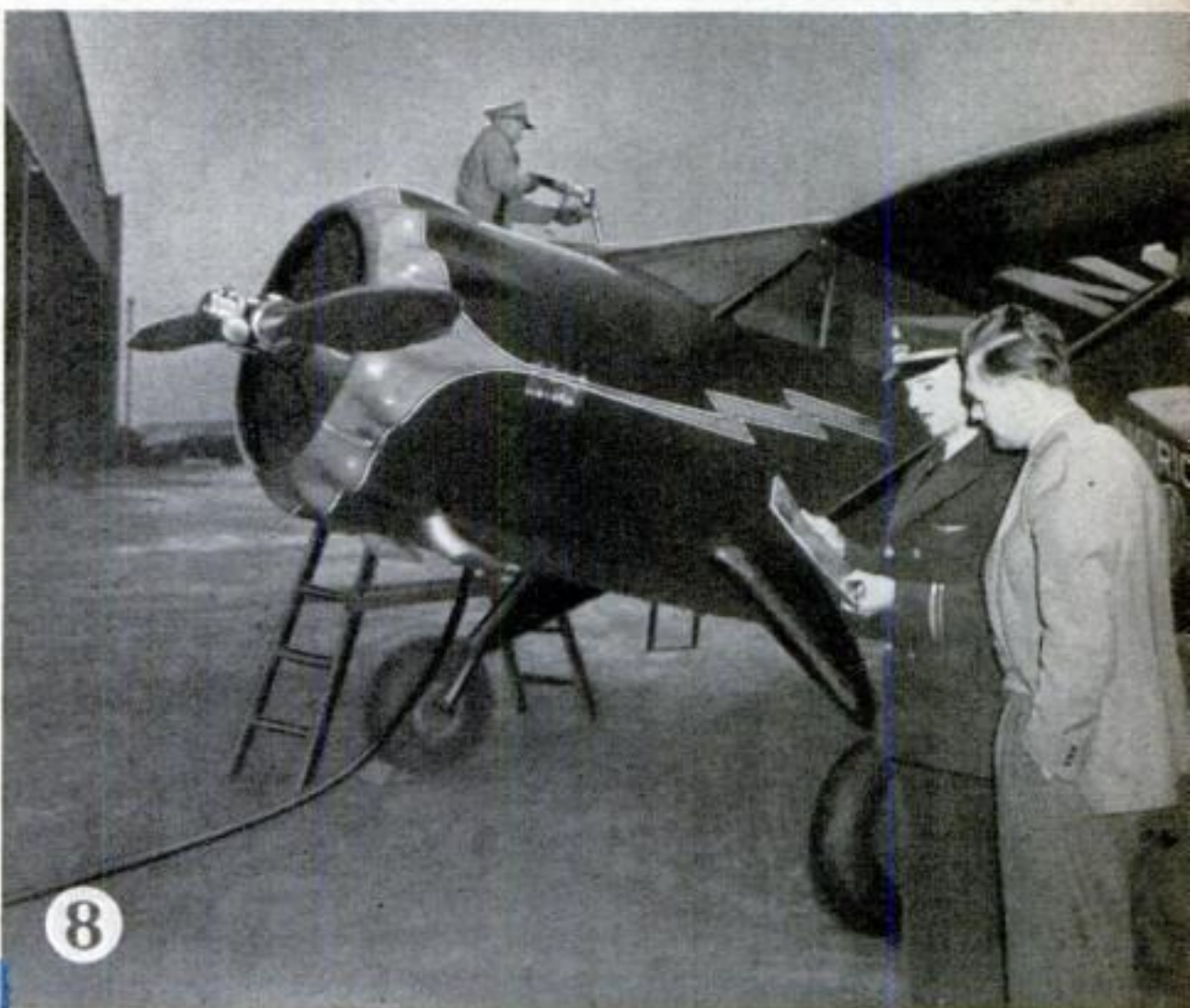
6 In the pilots' lounge, Hangar No. 1, they do their homework. It takes plenty of hard work to satisfy the airline officials that a young man is qualified to skipper one of the big flagships

lating systems, engines, and propellers.

In the school headquarters, they spent long hours under the hood of one of the school's two Link trainers, practicing navigation, instrument reading, location and meaning of radio-beam signals, and test approaches to various flying fields. Each time they emerged from their stationary flights in the Link, an instructor pointed out their mistakes as recorded by the automatic device that traces every movement of the imaginary flight.

Their first actual flying as student officers came in the company's Stinson trainer planes. Here the fledgling captains practiced instrument flying in the curtain-shrouded cockpit. From this they progressed to flights in the transport planes, and finally to fifty hours of "line checks," flights in regularly scheduled planes as a third member of the ship's crew.

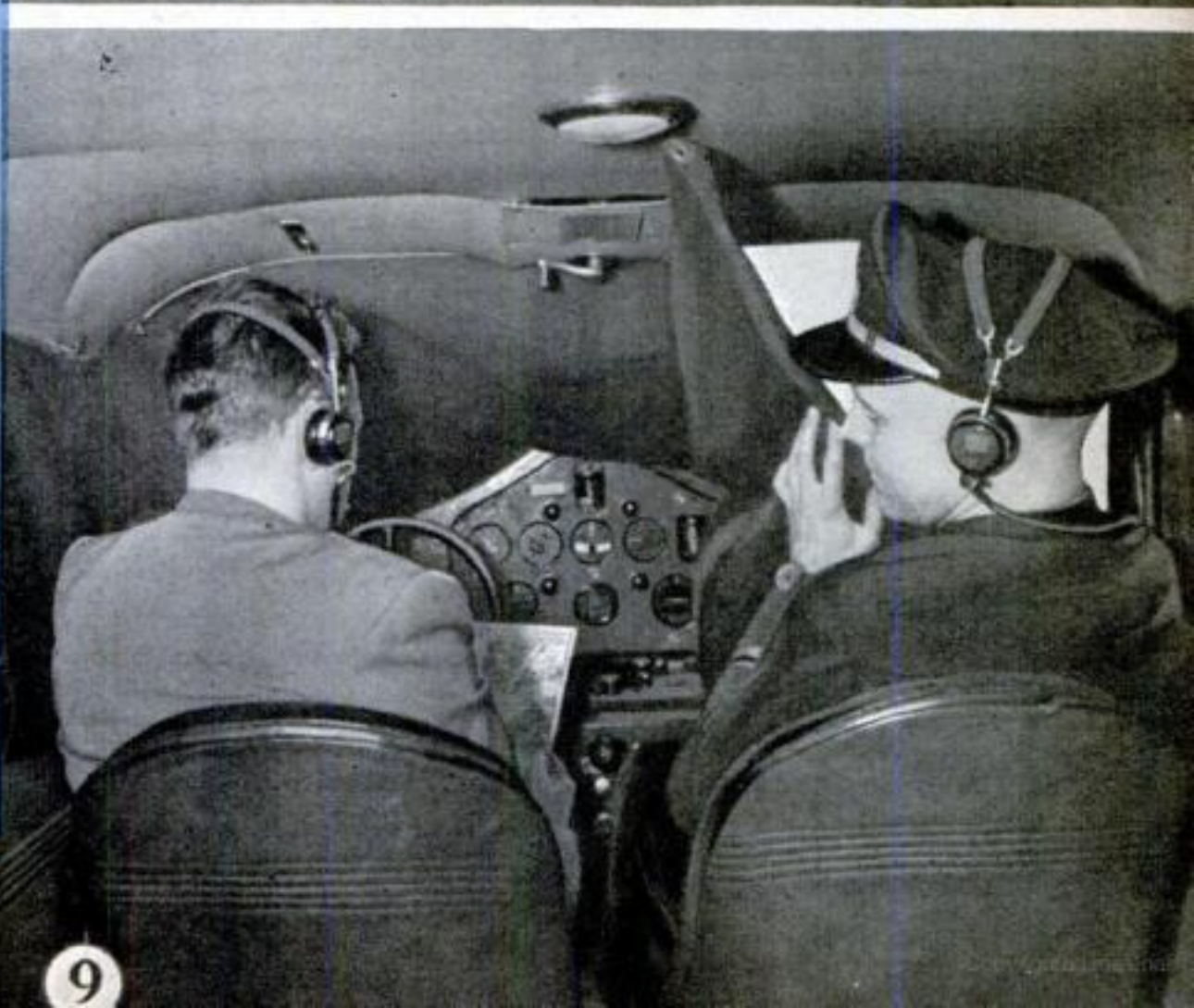
From this two-month period of intensive training, the students finally emerged as first officers, started to earn their monthly salary of \$100. Their pay will be increased twenty dollars every six months until it reaches \$350, when they should be ready for appointment as captains.

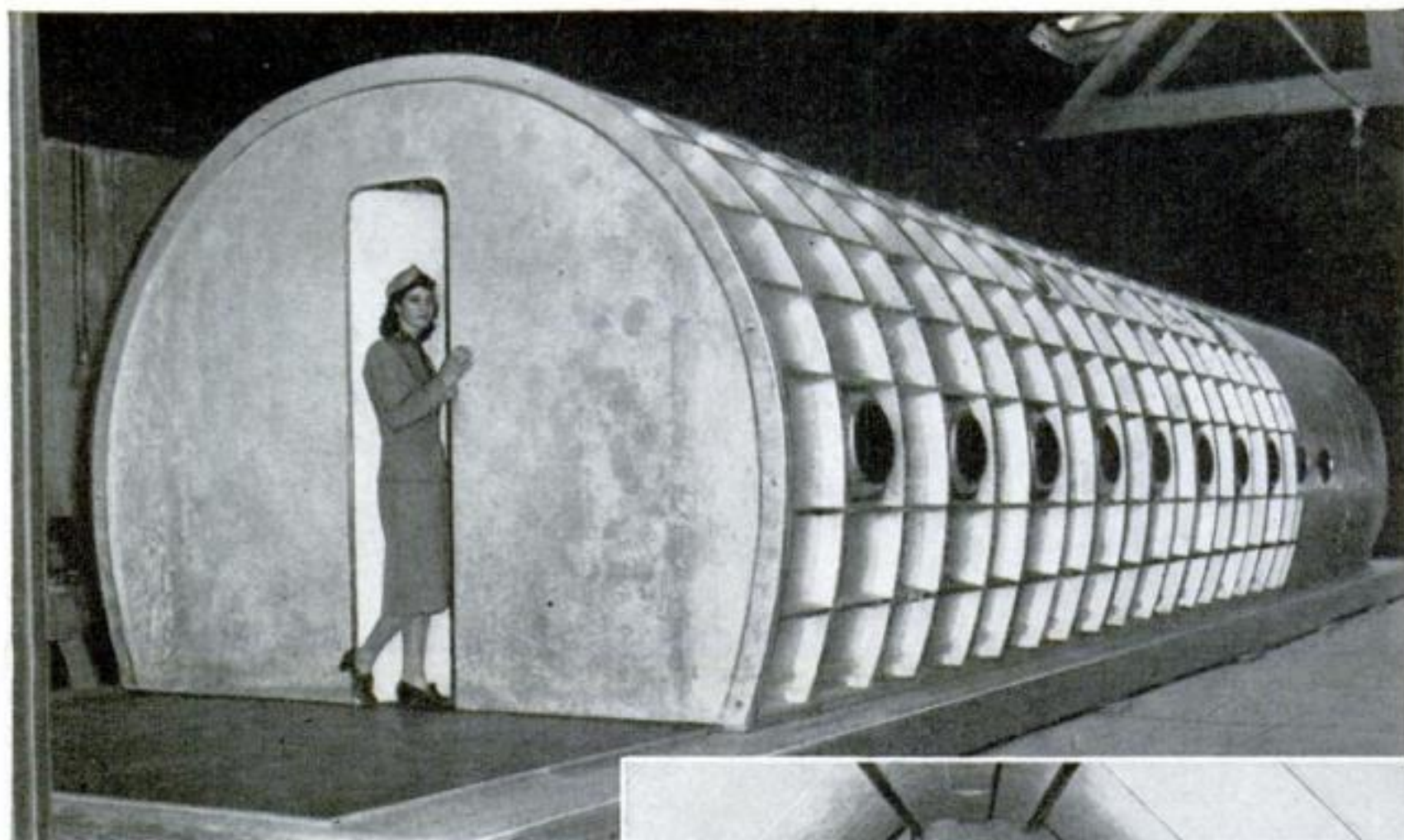


7 With an experienced pilot to coach them, they climb into the cockpit of a Douglas DC-3 for a practice flight. Soon they will know the complicated routine of flying one of these big airliners

8 Student Hatch, in uniform, is ready to take off in a Stinson training plane for a blind-flying test. After proving his skill in this smaller ship, he will go on to the regular transport craft

9 With a black hood covering the training plane's windshield, so that he cannot see out, Hatch prepares to take off, fly, and land with only his instruments and radio signals to guide him



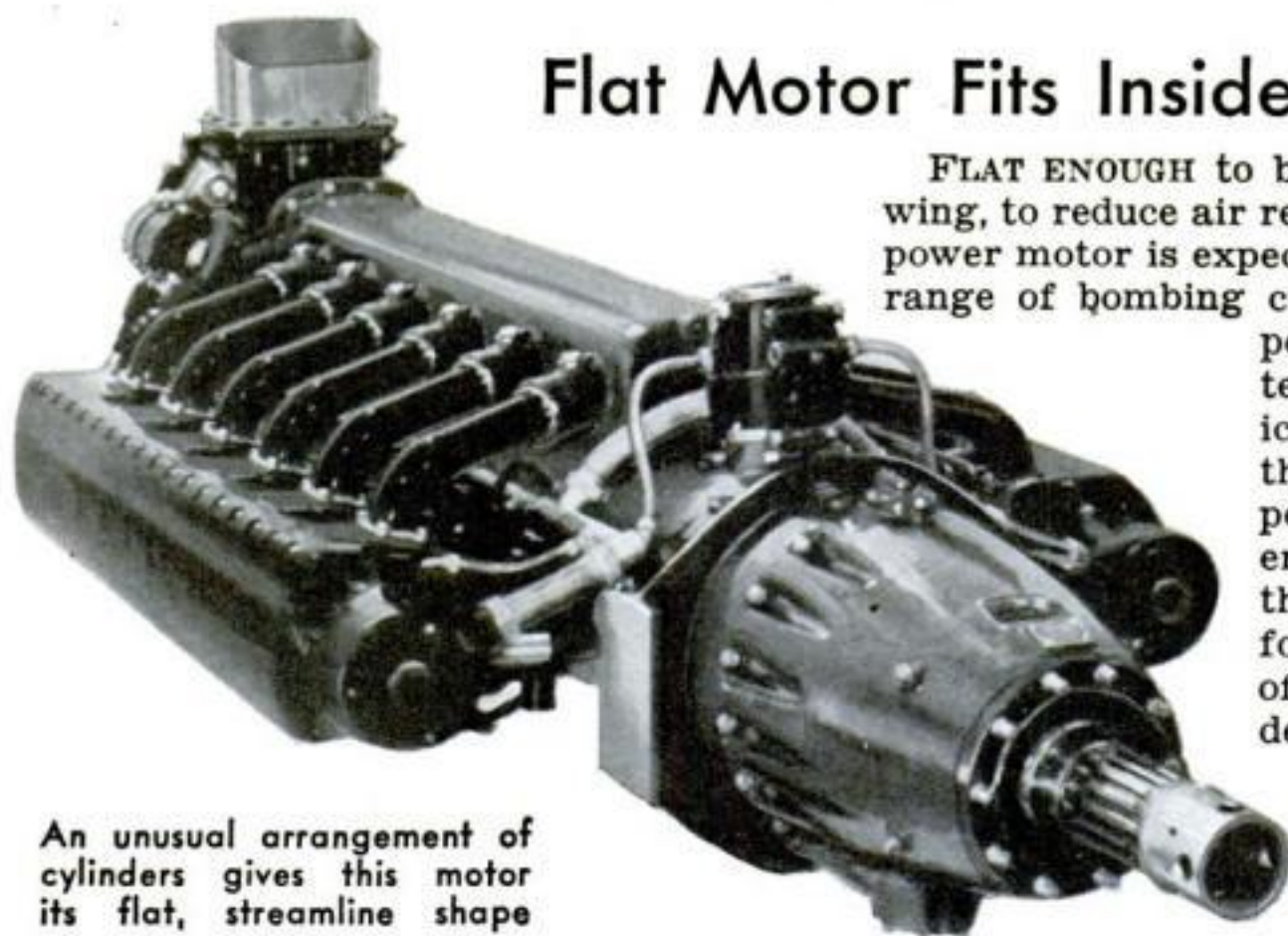


Air Hostesses Train in Dummy Cabin

A BARREL-SHAPED, full-size duplicate of an airliner's cabin serves as a schoolroom for United Air Lines hostesses. It also helps in planning interior fittings for giant forty-passenger planes that the company will put in operation next year. Built at Burbank, Calif., the \$10,000 wooden model measures sixty feet long—the length of an actual fuselage minus the pilots' compartment and the tail section.



Hostess chats with "passengers" in the sixty-foot model of a transport-plane cabin. In the exterior view above, the door at the end corresponds to the opening from the pilots' cockpit



An unusual arrangement of cylinders gives this motor its flat, streamline shape

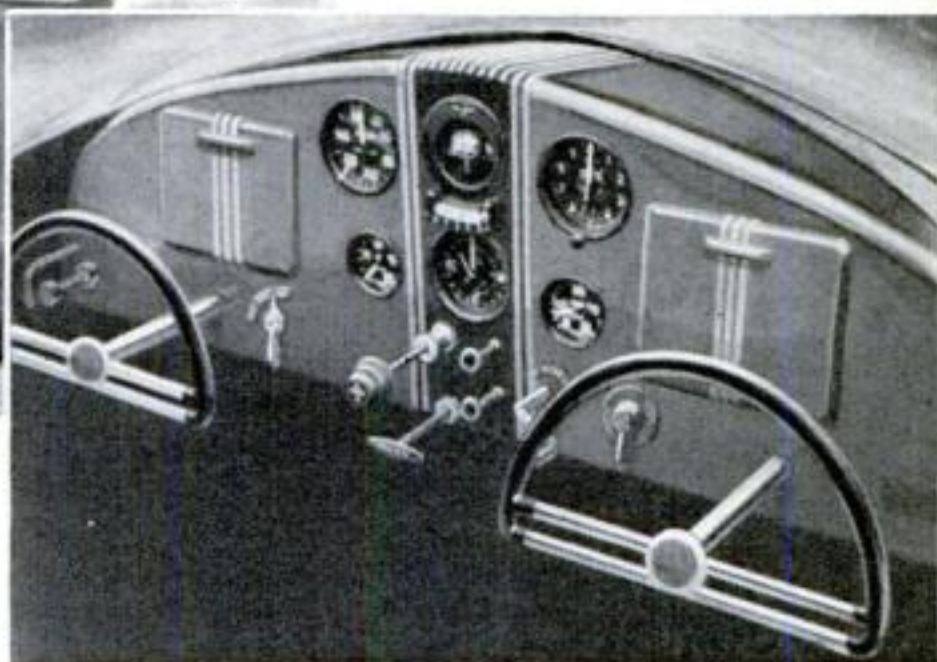
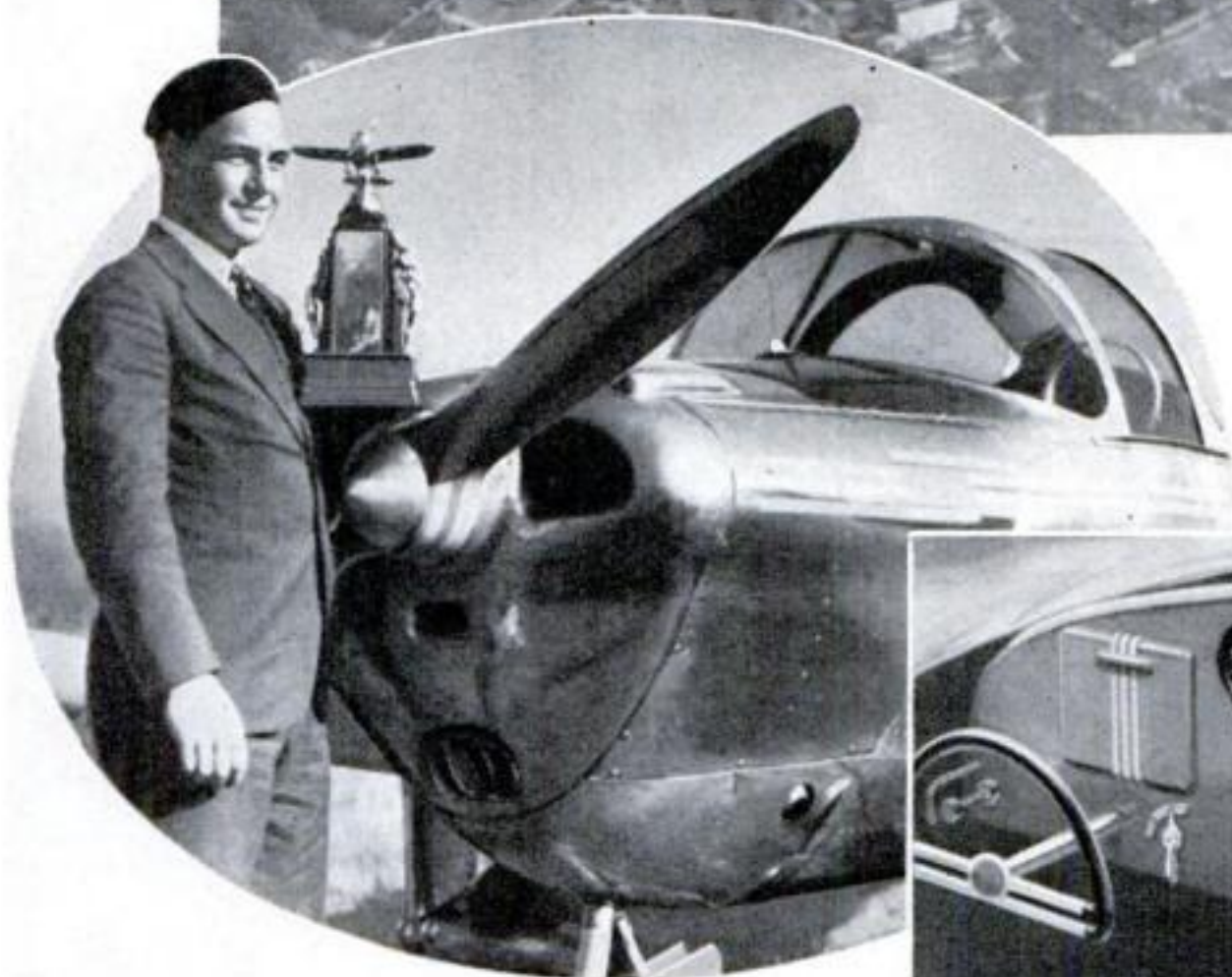
Flat Motor Fits Inside Plane's Wing

FLAT ENOUGH to be placed inside an airplane wing, to reduce air resistance, a new 1,200-horsepower motor is expected to increase the cruising range of bombing craft by as much as fifteen percent, and their speed by ten percent. A leading American maker collaborated with the U. S. Army Air Corps to perfect the liquid-cooled power plant, which measures only thirty-seven inches high by forty-four inches wide. Six of the engine's twelve cylinders are mounted on each side of the crankcase, as shown at left. The motor weighs slightly over a pound for each horsepower unit.

"Owl Plane" Can't Spin or Stall



The new light plane in flight over Washington, D. C. Left, Lieut. Robert Sanders with a trophy he won in the owl-faced craft. Photo below: the cockpit with dual wheels of the simplified controls



AN OWL-FACED plane of new design, said to be incapable of spinning or stalling, combines a variety of attractive features for private flyers. Handled like the wheel of a car, a control wheel steers the all-metal craft by operating its rudder and ailerons simultaneously. On the ground, the same control turns a nose wheel for taxiing. Transparent panels give all-around and overhead vision for take-offs and landings, and for keeping out of the way of other planes in the air. A tricycle landing gear and special air-cushioned shock absorbers help to set down the two-seater machine gently. Hydraulic wheel brakes bring it to a full stop within 200 feet, so that any small field may serve as a landing place.

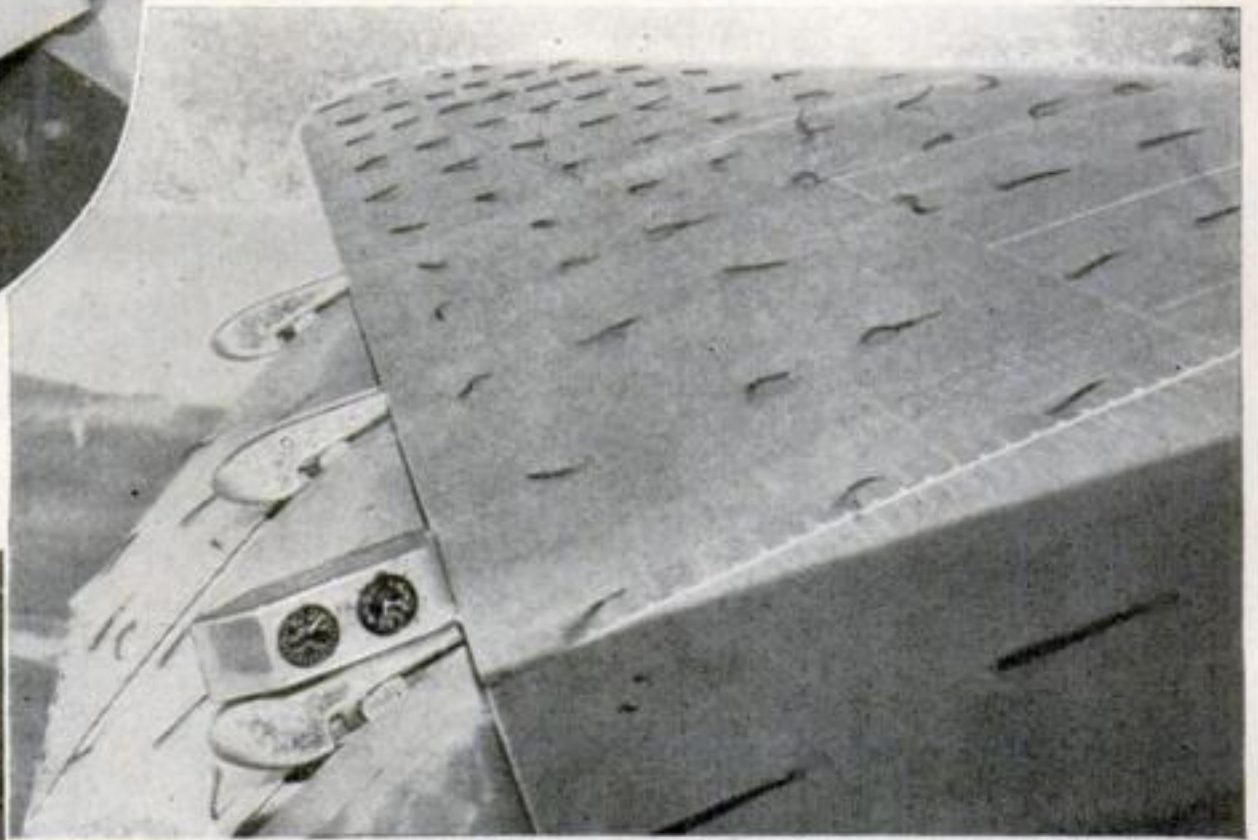
According to the maker, the new plane flies twenty-six miles on a gallon of gas, and a fuel capacity of fourteen gallons gives it a 350-mile cruising range. Its sixty-five-horsepower motor propels it at a cruising speed of 105 miles an hour, and a top speed of 117 miles an hour. Sturdy and powerful enough to be flown safely in weather that would keep many light planes grounded, the new model is said to have flying characteristics that cause it to be little affected by winds of as high velocity as fifty miles an hour.

NEW WAR PLANES

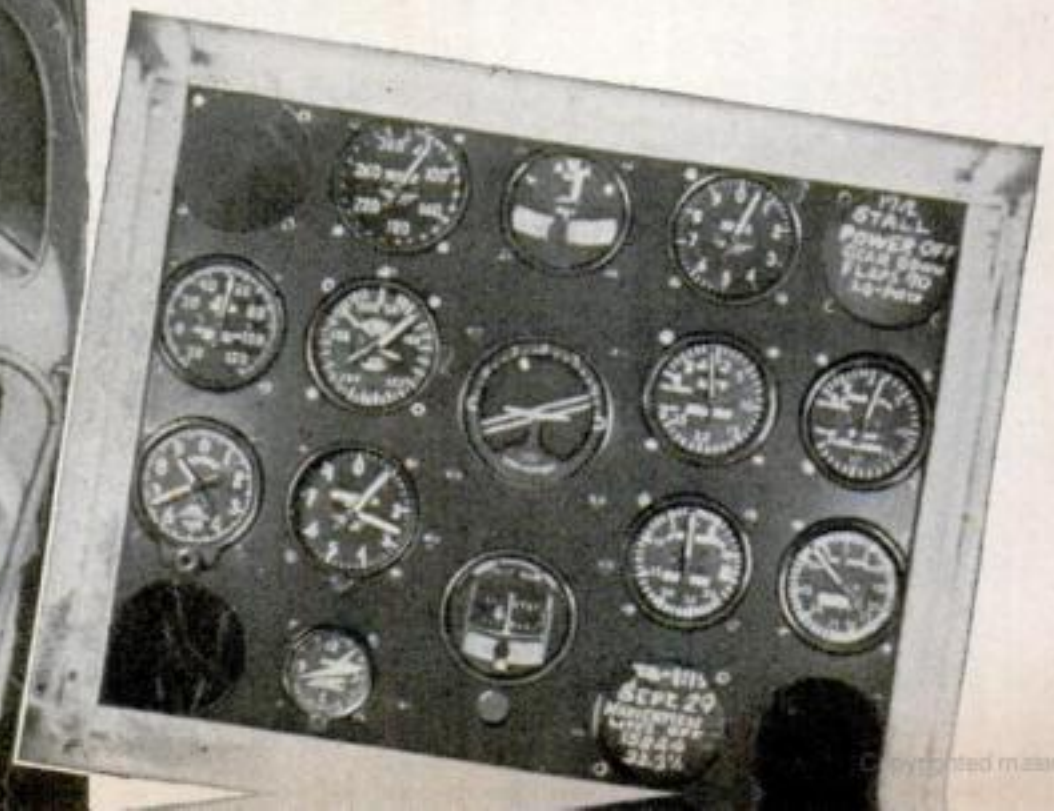


A fast reconnaissance bomber—one of the many war-planes being put through their paces in test flights

Motion pictures of bits of yarn glued to the wings, as at right, show the air flow during a stall



In the boxlike tunnel in the cabin of the plane at left, photographs are taken of a panel carrying more than a dozen instruments that show the reactions of the ship to flight maneuvers with wheels, flaps, and other parts in various test positions



GET THIRD DEGREE

MOVIE CAMERAS, bits of colored yarn, and a bomblike instrument lowered on a cable have been helping to check the maneuvering and landing performance of newly completed warplanes at an aircraft plant near Burbank, Calif.

Aloft on a test flight, the pilot, Milo Burcham, tries stalling a swift ship with power on and then off, landing wheels up and down, and wing flaps in various stages of extension.

Meanwhile the flight engineer, R. L. Thoren, takes movies of fourteen instruments housed in a miniature tunnel, and illuminated by powerful lamps. These "repeater" dials duplicate the readings of standard dials on the plane's instrument board. Resulting photos show simultaneously the plane's speed, the angles of its ailerons, positions of rudders and elevators, outside air temperature, direction of flight, and time to the second.

At the same time, an assistant operates a sixteen-millimeter movie camera bolted firmly to a steel post in the cabin and trained, through a window, on one wing. He photographs an air-speed meter, a clock, and the antics of seventy-eight short streamers of tinted yarn attached with glue to the upper wing surface. If the plane noses upward into a perfect stall, the strings nearest to the ship's fuselage, acting as tiny weather vanes, are the first to reveal eddies and

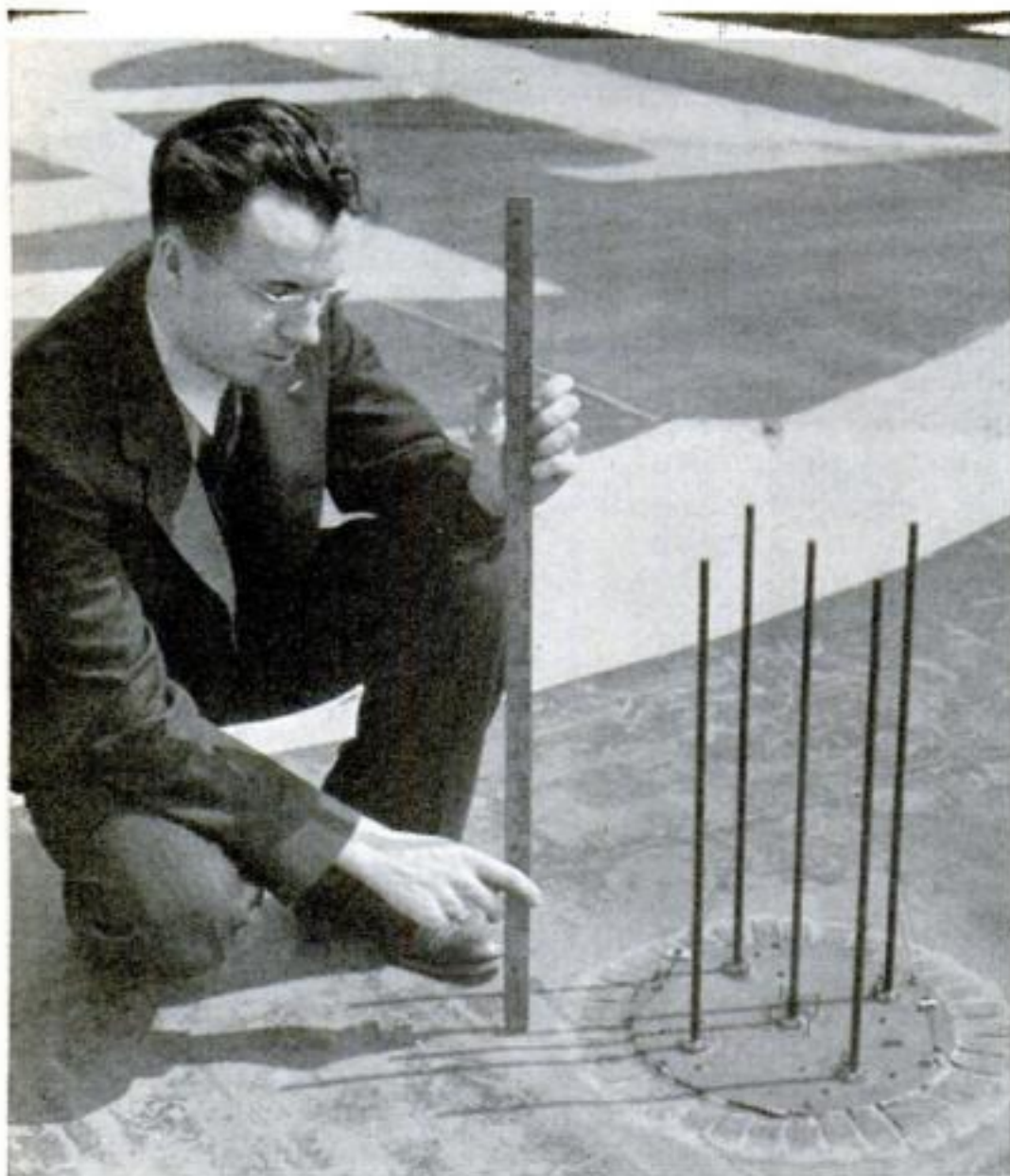
shifting movements of air flowing over the wing. Gradually the turbulence moves toward the wing tip and finally reaches the aileron, thus showing that lateral control is being maintained as long as possible.

To measure the secret top speed of the plane, an additional meter is lowered through a door. Shaped like a bomb, it points directly into the air stream, no matter how the plane turns.

After a flight, engineers analyze the speed figures and the two sets of movies. If the dials or pieces of yarn have revealed any shortcomings, necessary changes are made to correct them.



Top air speed—a closely guarded secret—is determined by a sensitive indicator in a bomblike device that is put out from the door of the cabin on a long cable. The bomb always points directly into the flow of air



The yardstick shows the size of the new radio-range antenna

Plane Radio Beacon, Like a Lighthouse, Has Rotating Beam

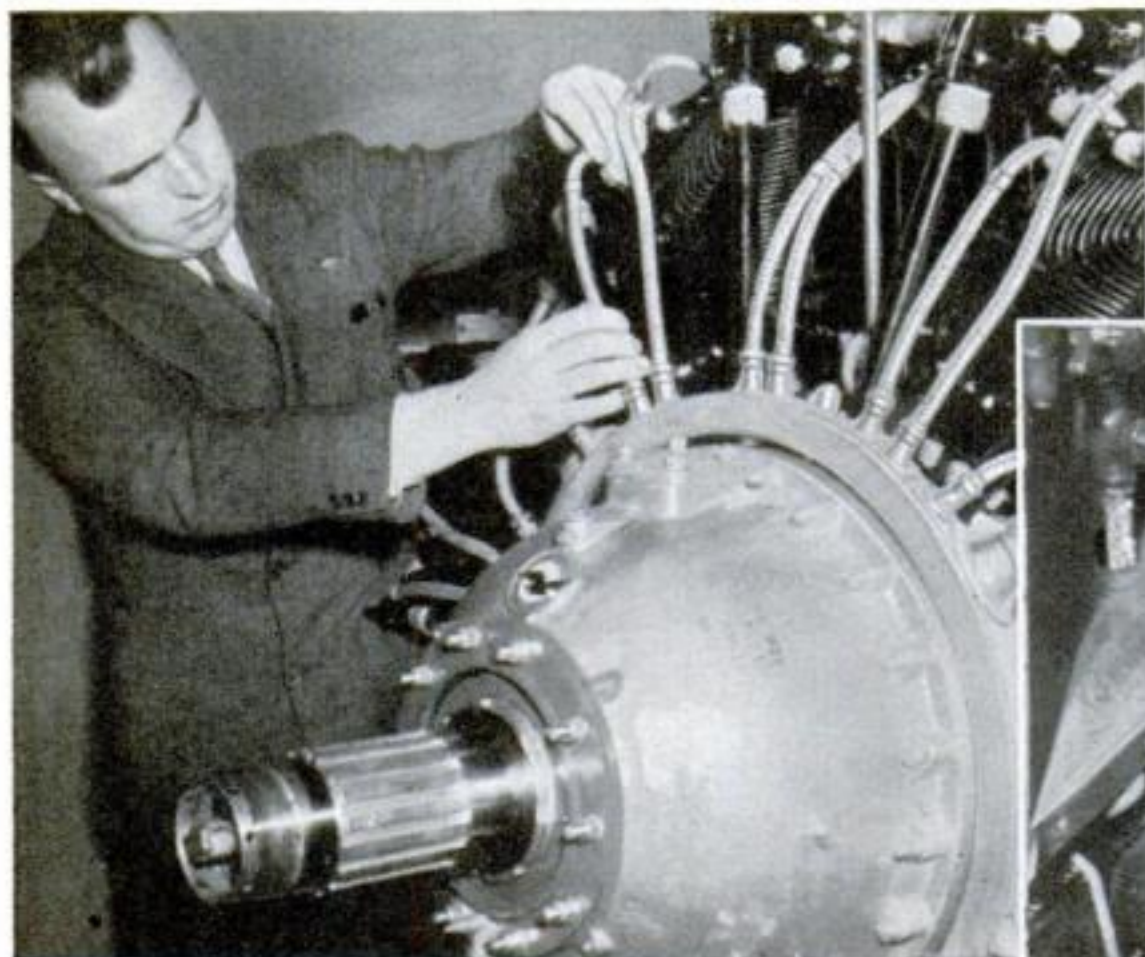
SWEEPING completely around the horizon at the rate of sixty times each second, a new radio-range beacon constantly shows a plane pilot whether he is flying toward the beacon or at an angle to it. Perfected by the Radio Corporation of America, the new system uses a tiny ground antenna consisting of five metal rods only two feet long and ten inches apart, set up as shown at the left. Previous systems have required towering antennas that present a flying hazard. In addition to the revolving beam, the system sends out a brief signal in all directions just as the narrow revolving beam points north. Responding to the two signals, a hand on a dial on the plane's instrument panel gives a continuous reading of the angle between the direction to the transmitter and the direction the plane is flying.

Supercharged Ignition for Airplanes

BECAUSE air within the shielding of the ignition cables of airplane engines becomes contaminated by moisture and combustion gases, permitting ignition leaks and speed-

ing corrosion, Carl E. Swanson, an air-line electrical engineer, developed an ignition "supercharging" system that forces thoroughly filtered air through the cables.

Air to the cables is forced through a flask containing filtering chemicals which last about a week in average commercial planes. The new system already has stood the test of 1,500,000 miles of flying.



Filtered air forced into the ignition-cable shields stops contamination. Note the tiny filter jar, right



He Breeds Bugs To Aid Science

A STRICT diet of "everything they like and plenty of it," is the good fortune of the guests of a boarding house for insects conducted as a spare-time business by James Brann, of Roslyn, N. Y. The bugs have little to complain about—until Brann ships them off in batches running as high as 5,000 at a time to scientific research laboratories all over the country. Bean beetles and Colorado potato beetles make up the bulk of the live stock in this novel bug ranch. Since they are voracious eaters, a careful watch is kept to see that they are well supplied with the plant leaves that they naturally prefer. In each large screened cage, sprigs of the preferred leaves are regularly replaced. Breeding is accelerated or halted by scientific control of the air in which the insects live. At eighty-five degrees F. and a high relative humidity, they breed rapidly, but when packed in mailing tubes and stored in a refrigerator, they become virtually dormant.



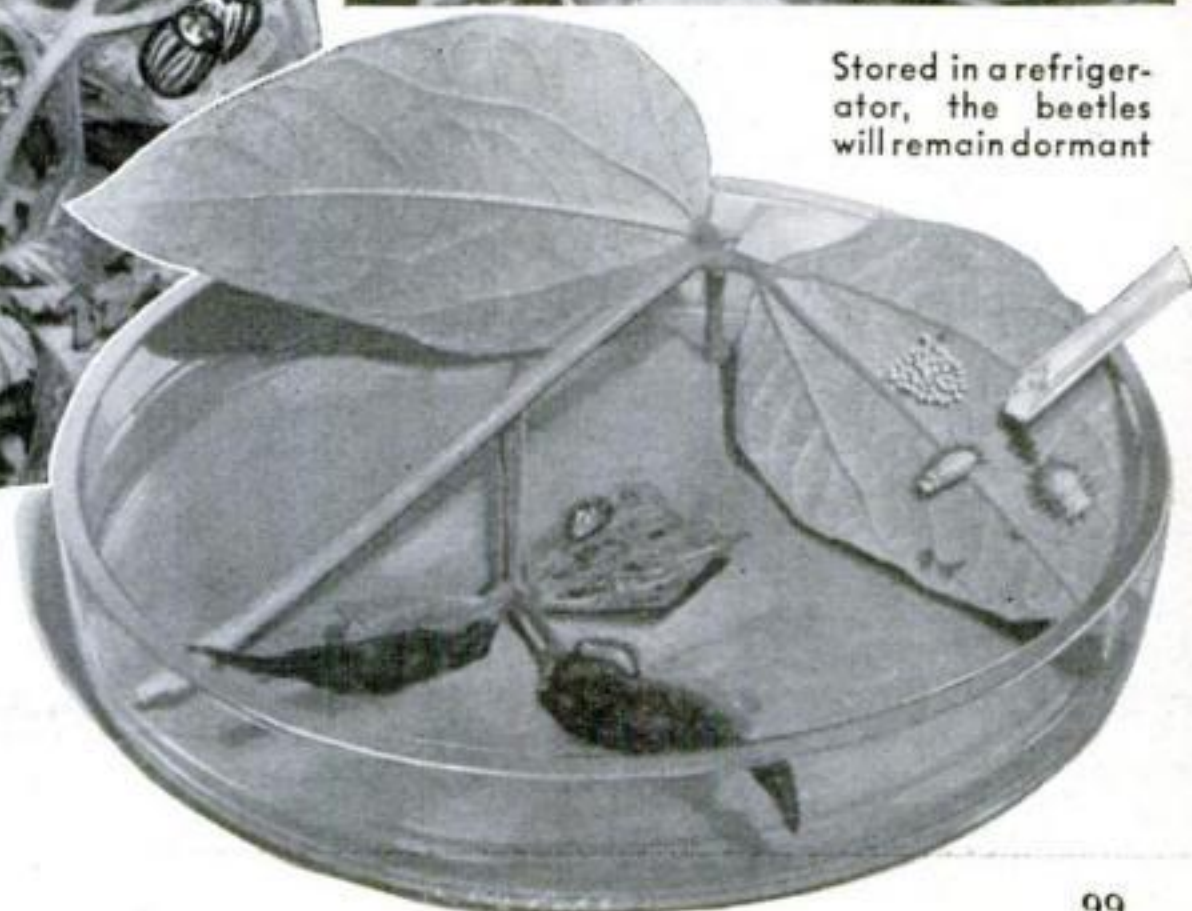
James Brann with a batch of his carefully bred beetles



Stored in a refrigerator, the beetles will remain dormant



Colorado potato bugs feeding on lush young tomato plants. Right, note the beetle eggs and several hatched-out larvae that will swell the beetle inventory



Radium Detective Uses

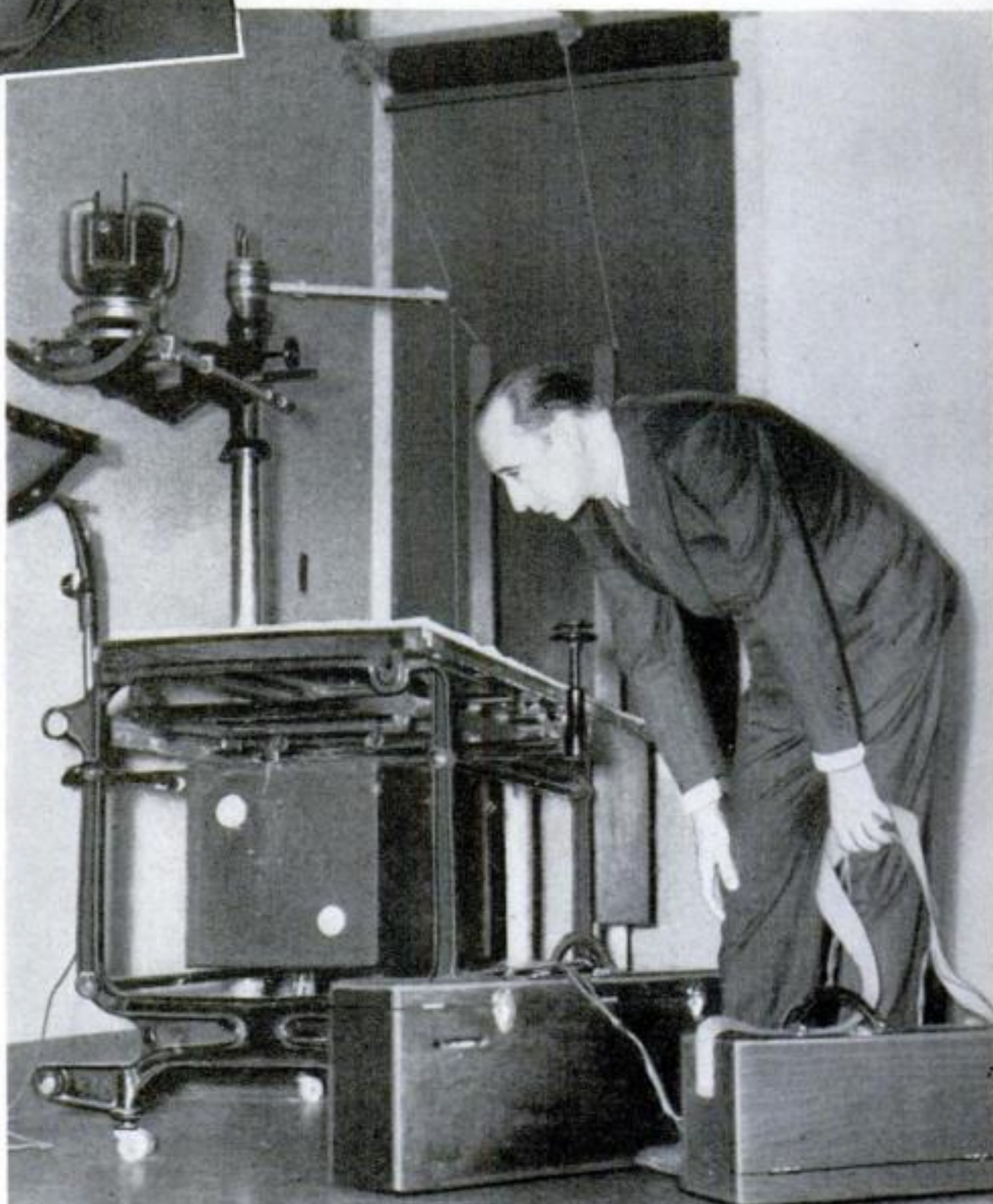


RECOVERING lost radium, with the aid of a homemade electric bloodhound that gives off a musical note instead of a bark when it nears its quarry, is the odd avocation of Frank Hartman, of Philadelphia, Pa. In the past five years, Hartman and his apparatus—which was constructed largely of spare radio parts—have recovered nearly \$80,000 worth of the precious, radioactive substance after it had been lost or misplaced in hospitals in and near Philadelphia.

At first glance, the case that houses the apparatus resembles a carpenter's tool box. Within are radio pick-up tubes, an amplifier, a power pack, and an electrical bell and gong. Batteries are carried in a second case. Rays given off by the radium cause the delicate mechanism to sound the bell or gong. Originally, Hartman used a loudspeaker, the disturbance caused by



Frank Hartman on the trail of lost radium in a hospital corridor. At right, he strikes a warm scent in the radium-treatment room. In the picture at top of page he shows the inside of an earlier apparatus he made to detect the rare metal



Electric Bloodhound

radium rays being amplified into a crackling like radio static. This noise proved disturbing to hospital patients, however, so the musical chime was substituted. For outdoor work, the bell replaces this gong. In either case, the telltale sound announces that radium is close at hand, the frequency of the sound increasing as the apparatus is brought closer and closer.

In a number of instances, Hartman has tracked down radium after it had gone through hospital incinerators. The radioactive substance cannot be destroyed by fire, so it remained unchanged in the ashes taken from the furnace. The difficulty lay in discovering which shovelful of ashes contained the radium. In some instances, Hartman has had to shovel tons of waste material before the rapid-fire sounding of the bell an-

nounced he had brought his quarry to bay.

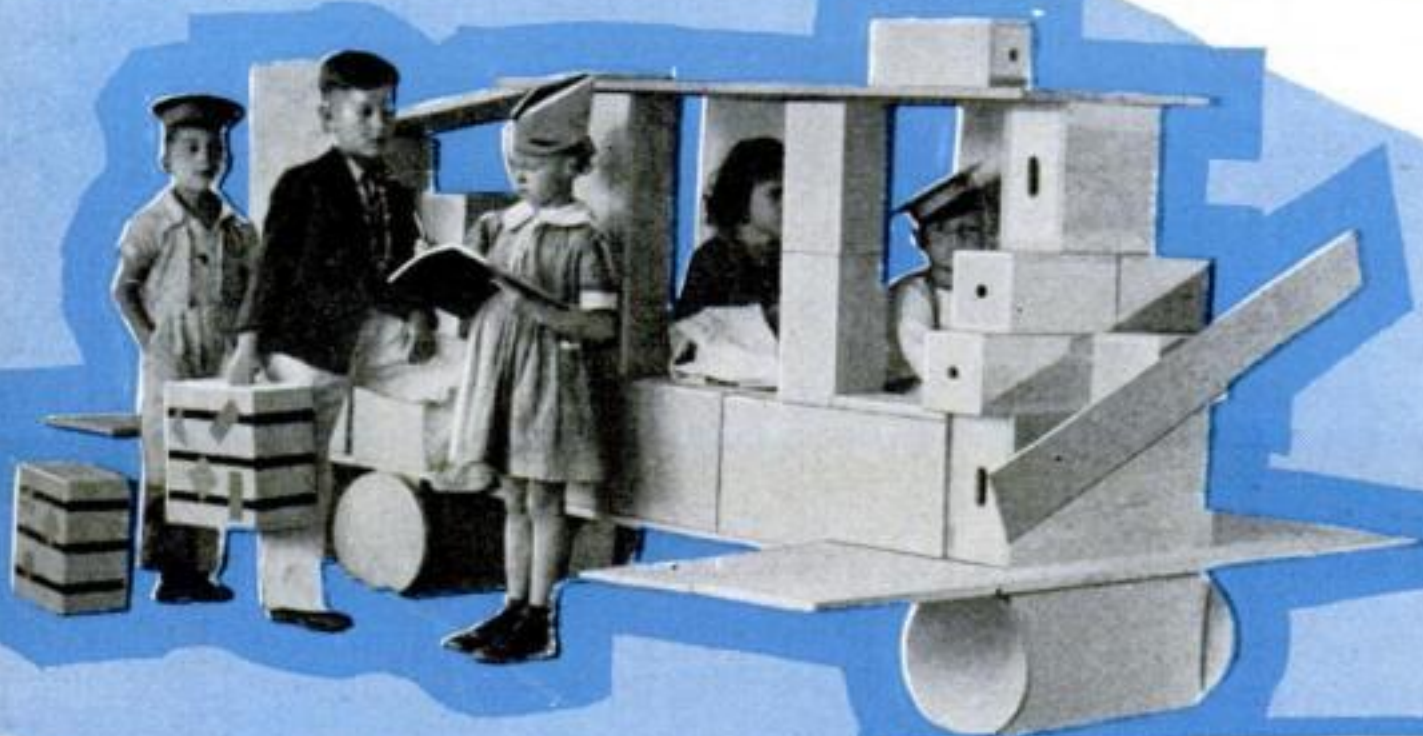
Sometimes the lost radium is discovered in hospital corridors, at other times in waste material on its way to the incinerator, and occasionally in the flaming furnace itself. In the latter case, the ashes are sifted as soon as they have cooled. In only four of forty-three attempts has Hartman failed to find the radium he sought. So sensitive is his homemade device that it will begin to sound its signal when it is as far as 500 feet from the radioactive metal and will track down quantities as tiny as one five-thousandth of a gram.



Hunting a radium needle in an incinerator haystack. When the precious material is brought close to the detecting device, a gong rings. In the upper picture, Hartman picks out the lost radium container with a pair of tweezers. It is seen in the circle—\$600 saved from the ashes

FROM PLAY JOBS

By
**ANDREW
R.
BOONE**



Elementary-school students at Burbank, Calif., play at air transport in a plane they built from blocks and boxes. Right, junior high-school boys use maps and recording instruments to study the weather

IN A schoolroom at Burbank, Calif., seven-year-old youngsters build a dummy transport plane. One of the boys occupies the pilot's cabin, a little girl stands at the door taking tickets, and others play the parts of passengers. Near-by, junior high-school students rebuild in miniature the Lockheed Aircraft Company's main plant; while others construct a map showing Southern California's mountains and airports. In Los Angeles, boys and girls of high-school age, and older, engage in fifty-one trades at the Frank Wiggins Trade School, putting on the finishing touches which prepare them to take real jobs in industry.

From kindergarten to graduation, industrial education in the Southwest follows a new pattern these days. In the lower grades, youngsters are encouraged to learn all they can about principal local industries. If the town boasts an aircraft plant or airport, they visit the scene and reproduce with cardboard and blocks what they see.

Such experiences carry many of the pupils on to special interests, which they are encouraged to develop in junior high and high school. In a hundred high schools in and around Los Angeles, boys and girls are being guided toward industrial jobs. Practice accompanies theory and their studies take on the realism of day-by-day work.



Educators know that most high-school students cannot find jobs immediately on graduation. It is to help avoid this loss in manpower that efforts are being made to fit men and women to industrial jobs, and in the Frank Wiggins Trade School, a free public institution administered by the Los Angeles City Board of Education, both youths and adults may prepare in all trades. Thousands who started by building planes from blocks become skilled aircraft designers, mechanics, and sheet-metal workers.

All students here work with their hands. There are no entrance examinations. Ad-

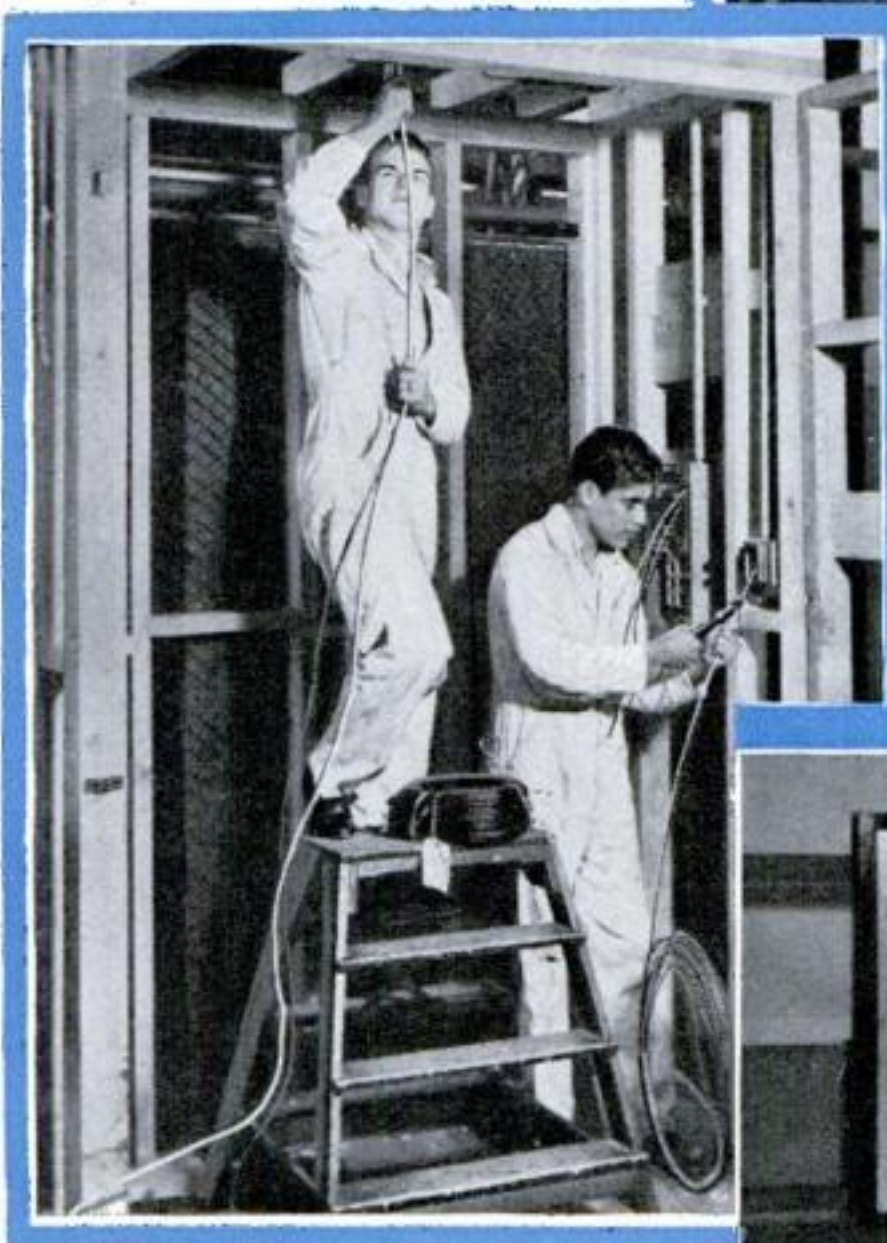
TO REAL JOBS

**Vocational Training
from Kindergarten
to High School Fits
Students To Follow
Careers in Industry**

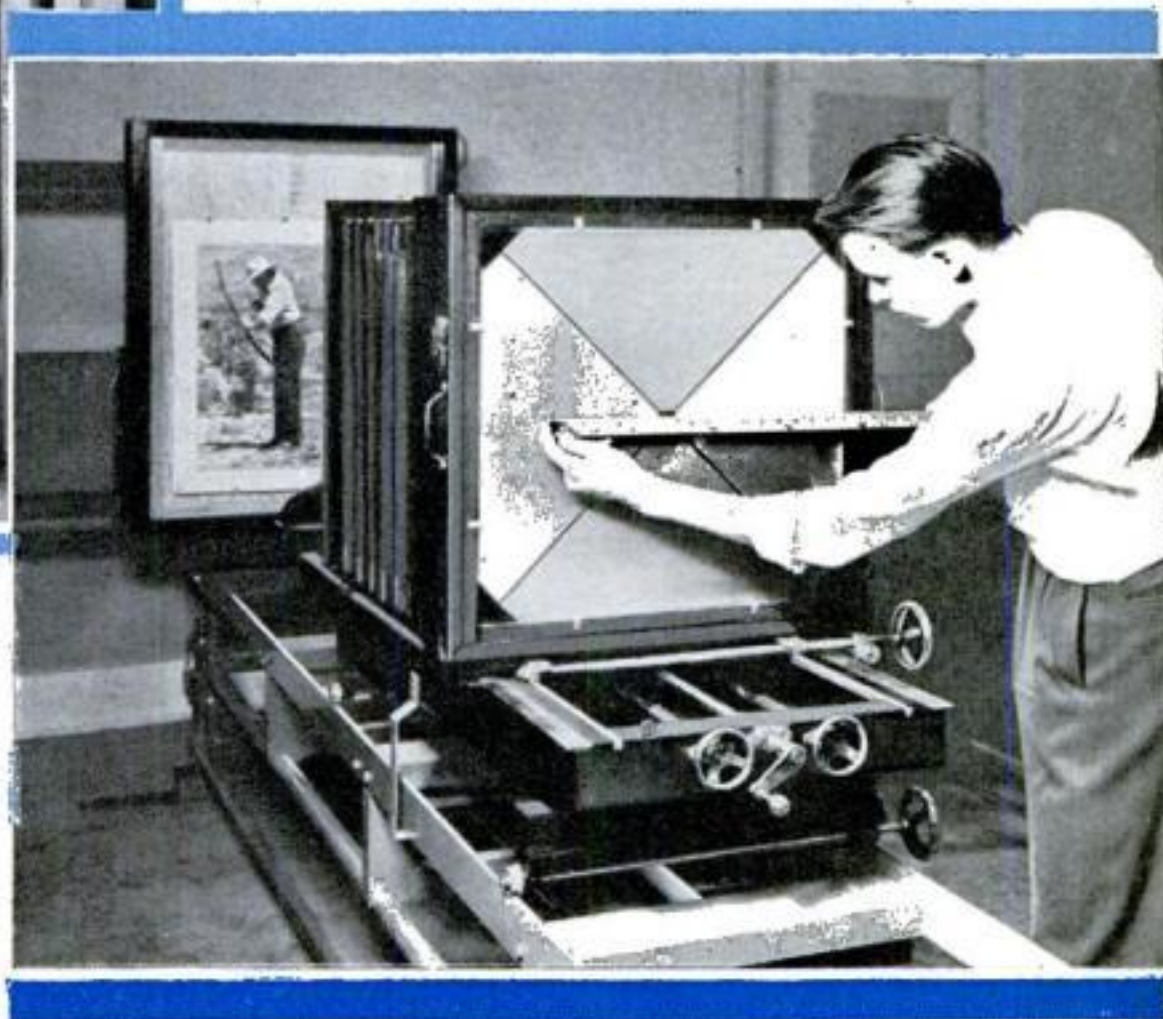


Finding jobs for students: a trade-school official confers with an expert on building-trades labor

Preparing for a career in industrial photography, this boy is learning to operate a copying camera



Embryo electricians install wires and other equipment in a model home on which student carpenters, brick-layers, plasterers, and painters will also demonstrate their skill



mission to classes is based upon the applicant's personal fitness to profit by the training and ability to meet the trade requirements for employment. Depending upon the demands of the trade for which he proposes to fit himself, he may either have finished the eighth grade, or high school. Since the school proposes not

only to train for, but also find a job, each student learns a single specialty.

There are no terms or semesters. Students may enter any time, and leave when they find employment. Advisory committees rep-



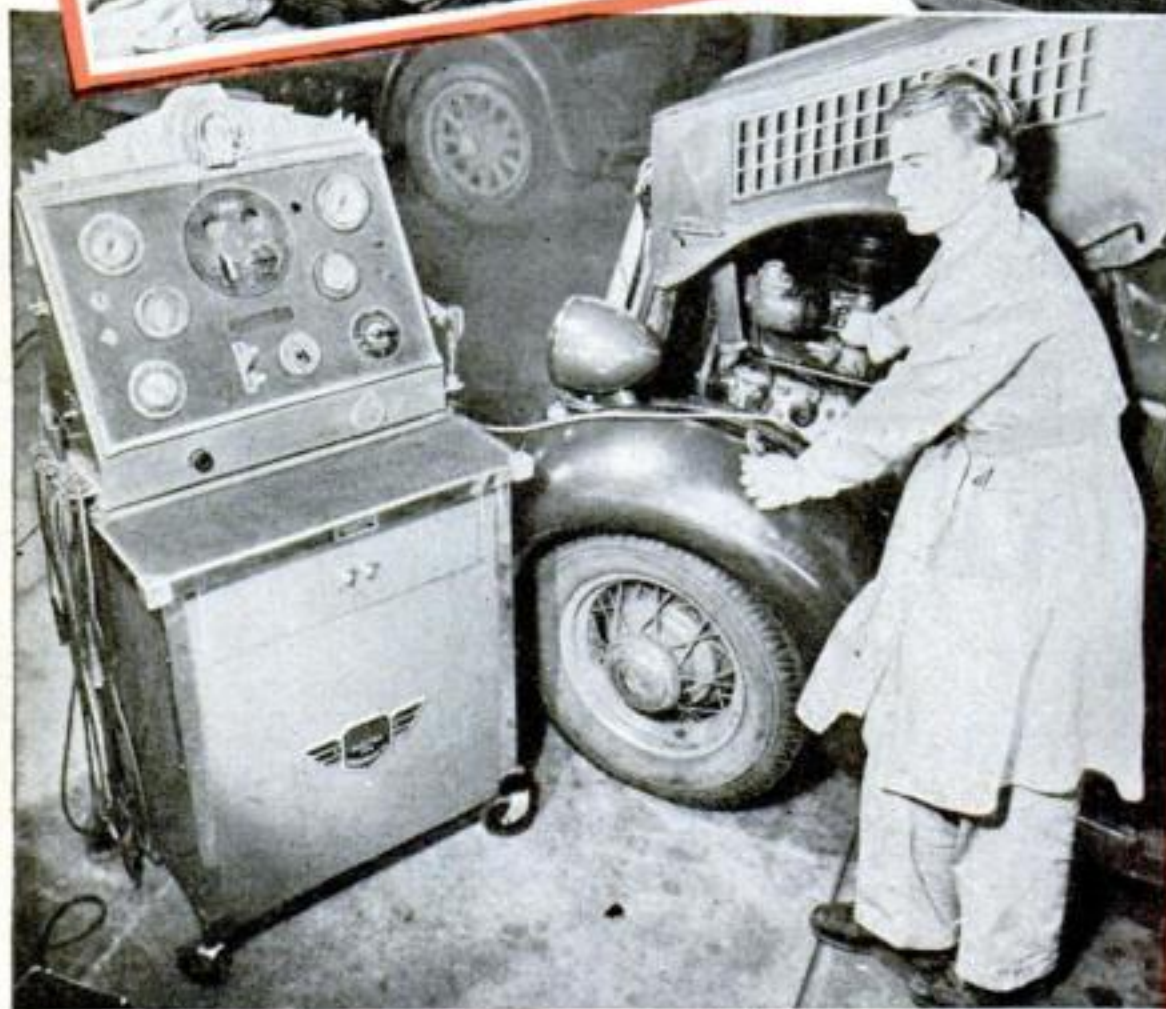
A student learning telegraph-office routine. Many large industrial concerns lend equipment to the trade school to help supply competent workers

representing 201 employment levels meet regularly with the instructors, mapping study courses and finding jobs for both boys and girls. But the school's influence does not end here. Workers already employed flock to the classrooms, where they learn new industrial developments in their various fields and perfect themselves in modern working methods.

After a student has left school, thousands of follow-ups trail him for years, for trade education of this sort, to be completely successful, must make sure that square pegs are fitted into square holes. Because of these intensive systems of try-outs in the elementary schools and specialized one-job training in the trade school, employers figuratively stand in line waiting to hire trade specialists the minute their instructors pronounce them qualified. There's no wait between the Frank Wiggins certificate of eligibility and a job. These boys and girls know where they're going.



Commercial art is only one of the forty-three kinds of work taught to girls. This student is sketching a shoe for an advertisement. Special aptitudes shown in early studies determine later training



Boys learning to be automobile mechanics must "eat their own cooking" by keeping their cars in repair. At the left, one of them is learning how to use a garage testing panel. In inset, another budding Gus Wilson is putting new finish on a fender

Completed cut-outs are attractive decorations for walls of a child's room

Cartoon Characters Cut Out of Wood

FIGURES of characters seen in moving-picture cartoon features are outlined on soft wood boards recently put out in packaged form by a novelty manufacturer as an educational toy intended to amuse and instruct children. The outlines make it easy to cut out the figures, which may then be painted in appropriate colors and fastened to play-room or nursery walls for permanent decorations, as pictured in the photograph at the left.



Billy Lee, young movie actor, applying colors to figures of animated-cartoon heroes and heroines cut from soft wood



College Course Helps Janitors Brush Up

A COLLEGE course for school janitors is a novel addition to the curriculum of Teacher's College, Columbia University, in New York City. Given under the supervision of Dr. Henry H. Linn, once a janitor himself and now superintendent of grounds and buildings at the school, the intensive course runs for five days and includes instruction in the best methods of sweeping floors, polishing furniture, cleaning woodwork, and operating coal and oil-burning furnaces. Round-table discussions and student-teacher consultations are held.



Student janitors get some pointers on operating an oil-burner furnace

New Eyes and Ears

SPECIALLY built classrooms, novel sound-amplifying systems, and many other scientific aids are now making it easier for school children who are handicapped by defective hearing or impaired vision. Photographs on these pages show how it is done at Long Beach, Calif., where education authorities have provided a striking example of the latest technique.

Each pupil suspected of deafness, among

the 25,000 children in the Long Beach public-school system, receives a test with an audiometer. This instrument, outwardly resembling a radio cabinet with headphones, determines how much a child actually hears.

Pupils showing marked impairment of hearing enter a special class, whose teacher talks into a microphone connected to an amplifier. They listen through earphones. By turning a knob on an individual control box, each member of the class can adjust the volume of sound until he hears distinctly.

Kindergarten pupils, some as young as three years old, may have trouble in learning to talk because they cannot hear their own words. To overcome this difficulty, a child watches the teacher's lips and feels her breath on the back of his hand, or places a hand against her throat, while at the same time he tries to

At the left, a child believed to be hard of hearing is being given a test to show how well she hears



To exercise a weak eye, this youngster wears a rubber cup over his normal eye. At right, a deaf child learns to form speech sounds by watching the teacher's lips and feeling her breath on his hand



for Students



Children with impaired hearing listen with earphones while the teacher talks into a microphone. Each has a control box with a knob to regulate sound volume

imitate the sound she is pronouncing. The feel of his own breath or throat serves as a guide. Corresponding sounds appear in large letters on a near-by blackboard.

For pupils with subnormal vision, special aids include reading racks for books, tilt-top desks, glareless tinted paper, and over-size pencils and chalk. Even the classrooms are designed to relieve strain, and studies are changed frequently to rest the eyes. If only one eye is impaired, it may be exercised by placing a rubber "blinder" over the good one. Some children learn typing on machines equipped with large type. These sight-conservation classes enable students to attend school even when being treated by an eye doctor.

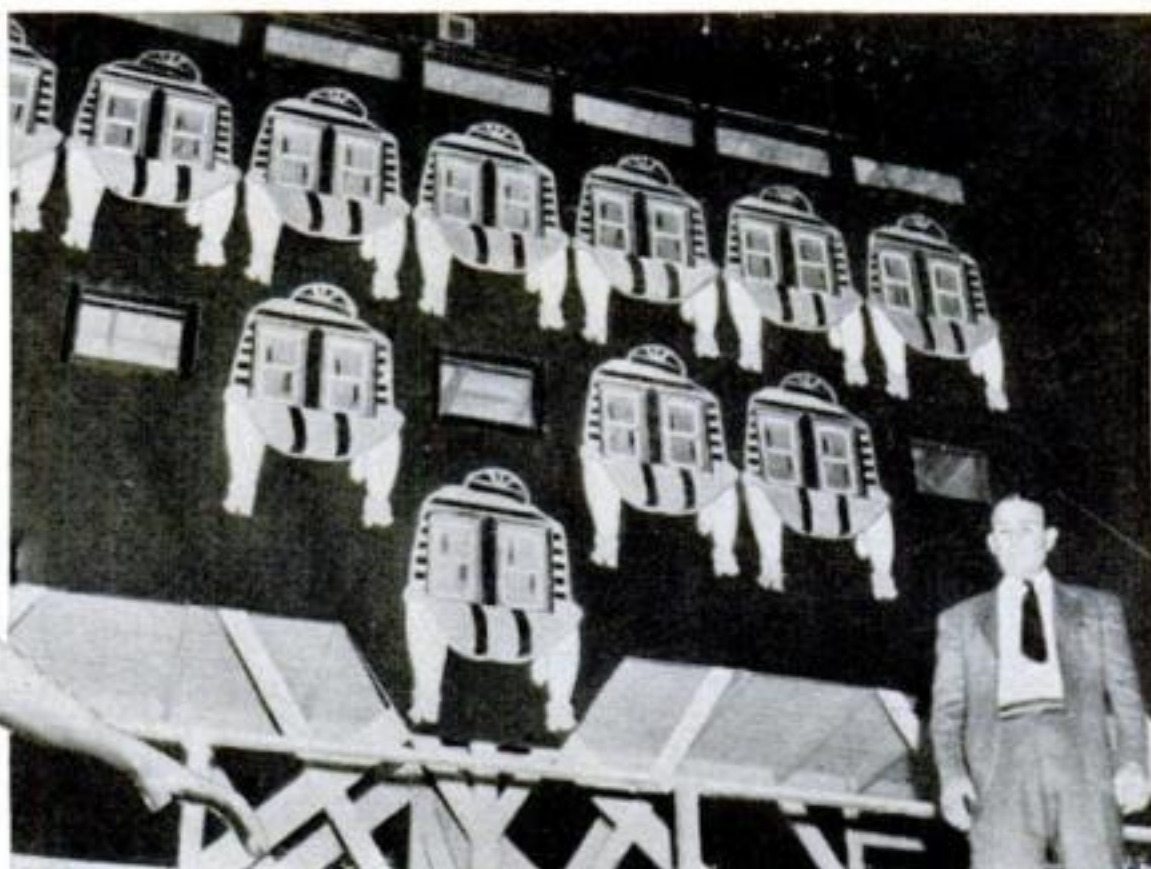


A tilt-top desk brings this student's work close to his eyes. Over-size pencils and glareproof tinted paper reduce eye strain

One-Wheel Skate for Rough Ground



ONE-WHEELED roller skates provide a novel means of locomotion for a young inventor of Los Angeles, Calif. The oversize wheels adapt the skates for use in places where there are no sidewalks or paved roads.



Coach Uses "Blocking Recorder"

TO AID in training football players, a "blocking recorder" has been devised by a Texas coach. Figures on an illuminated panel, illustrated above, correspond to the eleven men of a team. Watching a practice play, the coach flashes on a green light for each man who has made a block correctly, and a red light for each who has failed. By glancing at the recorder, members of the team get individual reports on their performance, without need of verbal admonition from the coach.

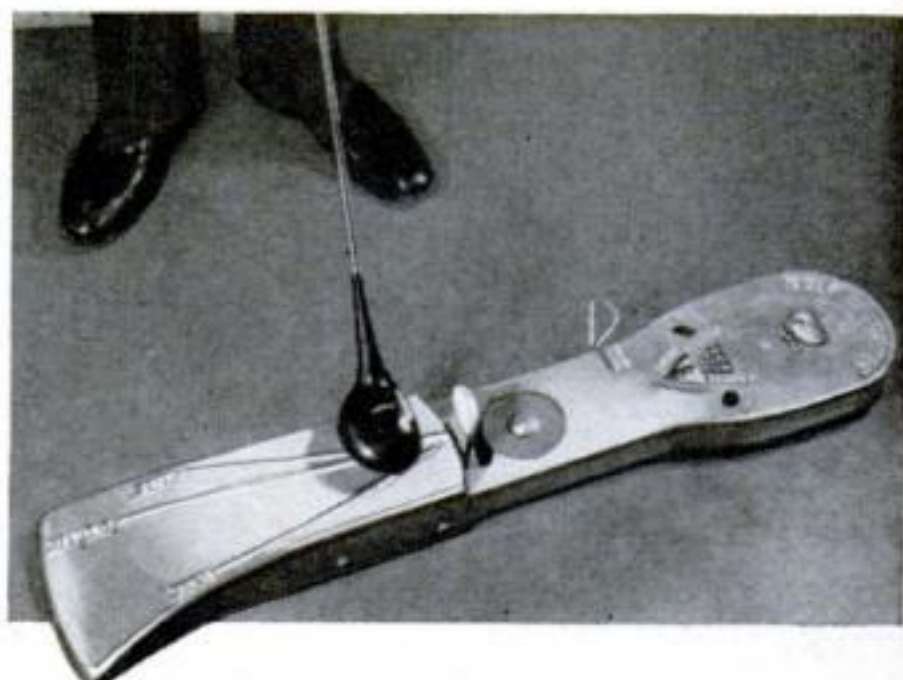
Wire Coils Clean Shotgun Barrel

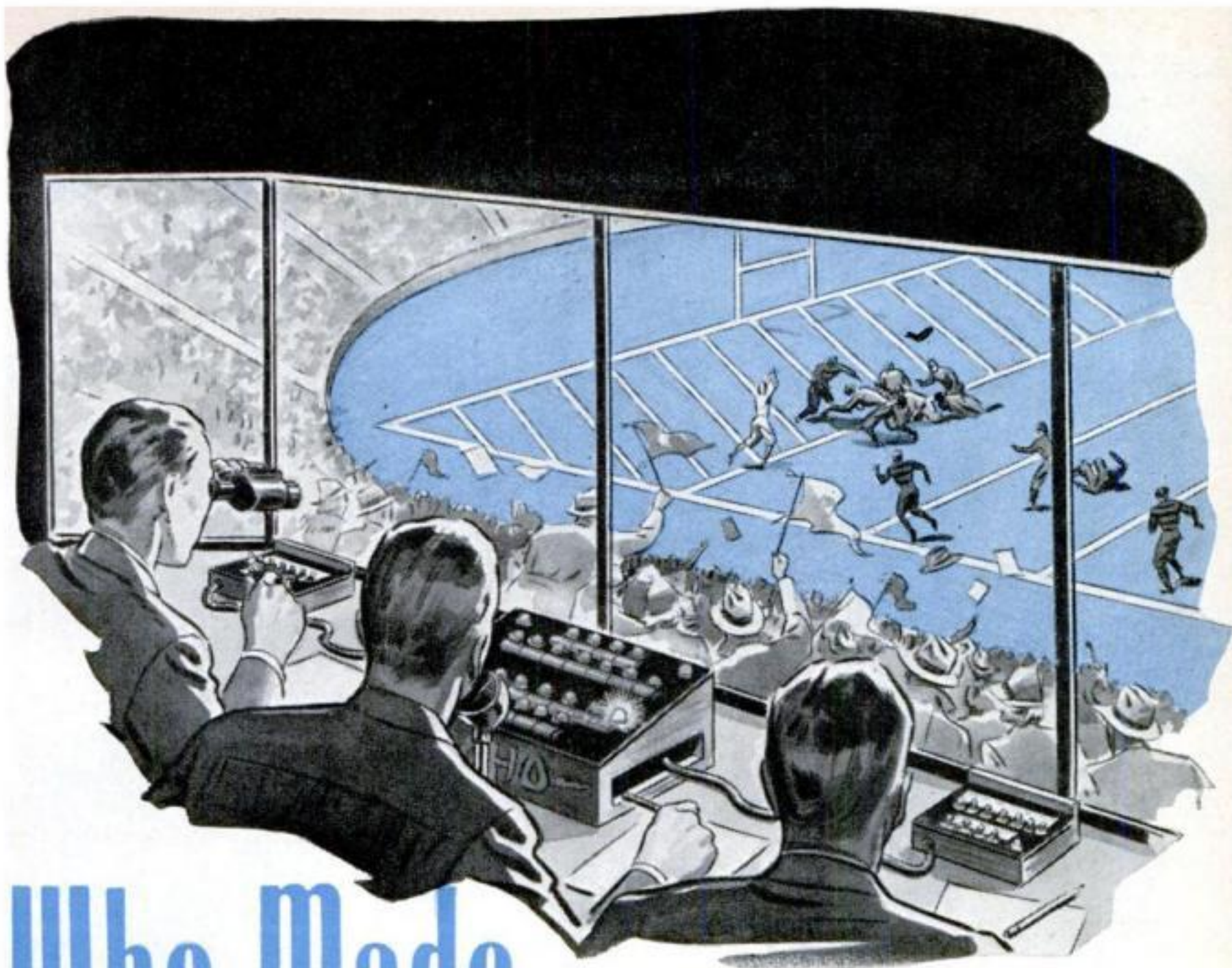


FOR cleaning a shotgun, a new tool employs self-sharpening coils of bronze wire, soft enough not to damage the steel barrel but hard enough to remove lead or rust. The device may be fitted to a regular shotgun cleaning rod or pulled through the barrel with a stout cord.

Golf-Drive Practice Aid Registers Hook or Slice

A NEW indoor practice aid for golfers not only registers how far a drive would carry, but also whether it was sliced or hooked. Upon the impact of the club, an upright piece of rubber bends to strike a circular disk, registering the distance of the drive in yards upon a dial. An arrow directly in front of the disk shows the direction the ball would travel and a lever at the side resets the mechanism for another try.



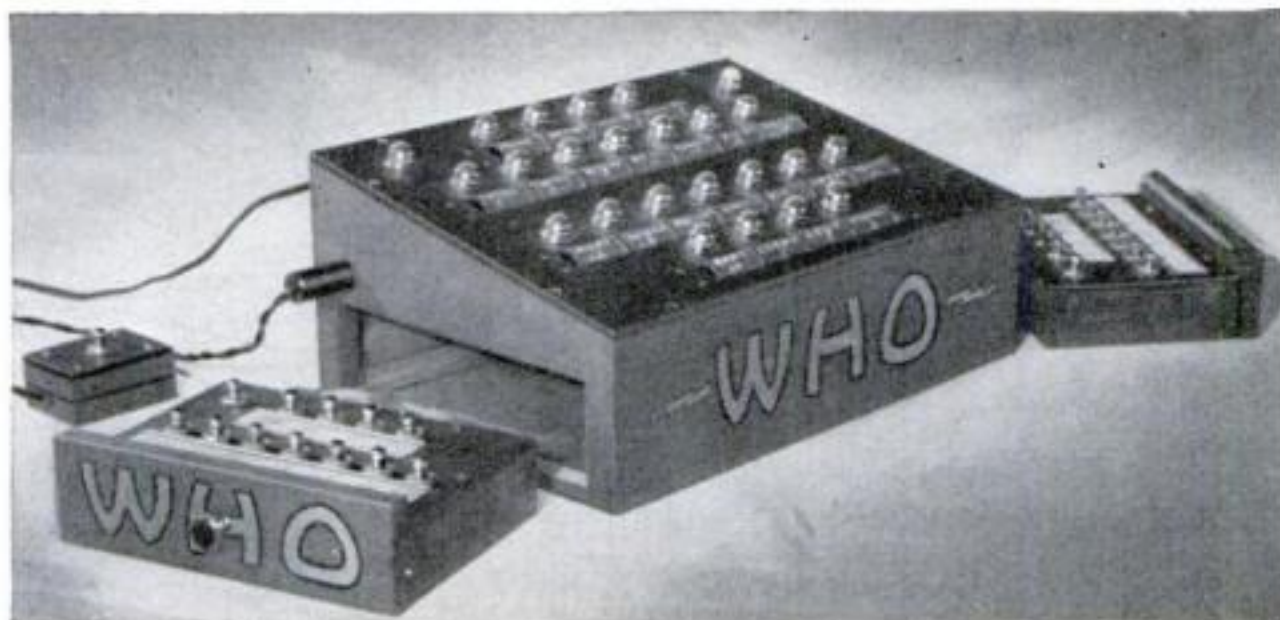


Who Made That Play?

**"SPOTTING" DEVICE
AIDS FOOTBALL
ANNOUNCER**

HOW can radio announcers follow the complicated maneuvers of a football game and still identify by name the ball carrier, tackler, and other players involved in the action? One answer to the problem, worked out by John Beeston, research engineer for radio station WHO in Des Moines, Iowa, is pictured below. In front of the announcer is a slant-top box equipped with lights representing all the players on the home and visiting teams. Wires lead out to smaller control boxes, one set in front of an assistant, or spotter, familiar with the visiting football squad, and another in front of a home-squad spotter. The smaller units contain eleven buttons, which actuate lights on the main board. As the teams go into action, the

spotters press buttons below the names of the backs or linemen engaged in the play, and lights flash on the main board to convey the information instantly to the announcer. If a spotter makes a mistake, he presses a twelfth button, which flashes a special light to inform the announcer and thus enable him to correct the error as soon as possible.



Lights on the larger panel identify players as "spotters" press buttons



Lightweight, Transparent Rain Suit for Golfers

PROTECTION from rain, without noticeable weight or interference with the wearer's freedom of movement, is afforded golfers by a transparent rain suit. The suit consists of a long-sleeved jacket and trousers.

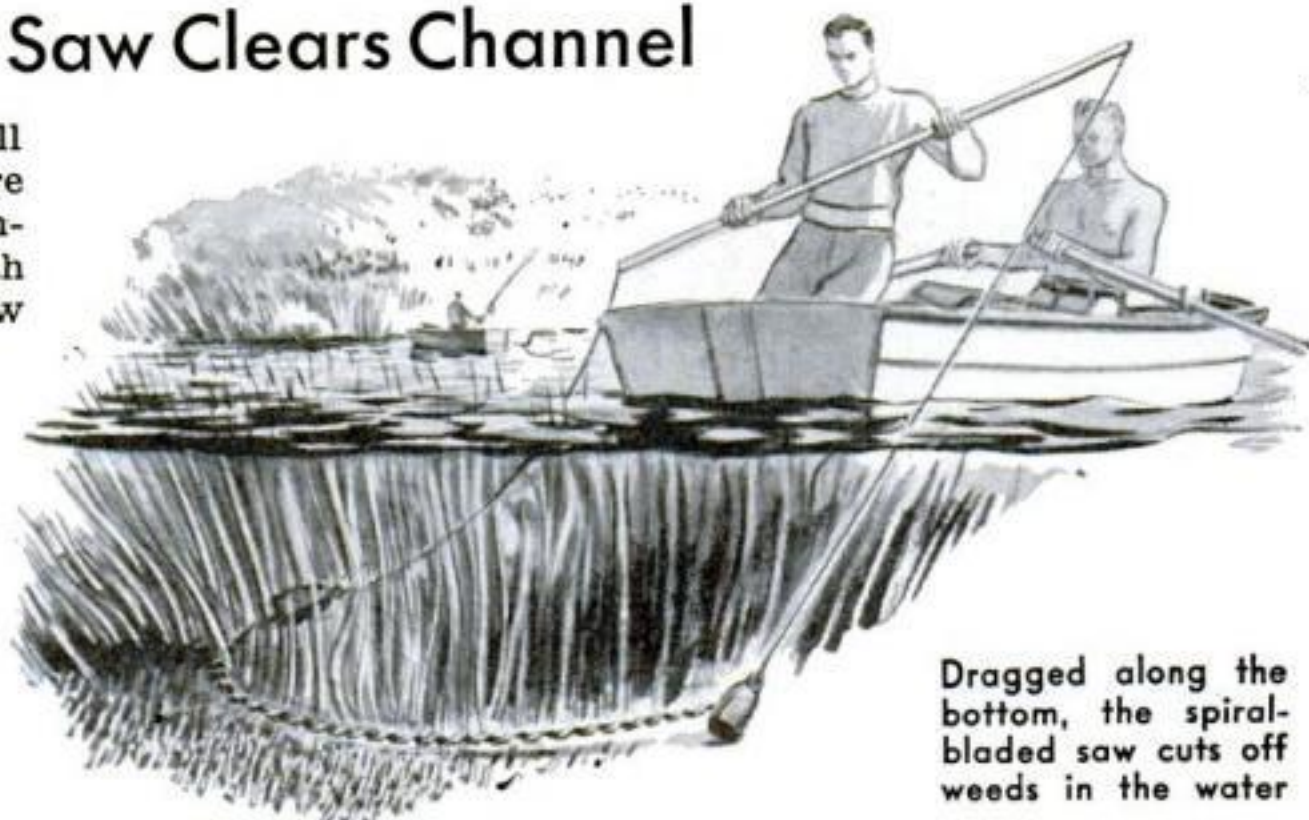
Face Net Protects Boat Racer

TO PROTECT the faces of outboard-motor boat-racing pilots from possible injuries in spills, Mike Rogowski, Detroit, Mich., Outboard Association official, devised the protective cord face net pictured below.



Anglers' Weed Saw Clears Channel

WEEDS that choke small fishing lakes and interfere with the activities of anglers can be eliminated with an ingenious weed saw now available. Weighted at the ends, the spiral-bladed, flexible saw is attached by cables to an operating handle and dragged along the lake bottom from a rowboat. The saw is said to work easily at any depth and to clear a ten-foot channel.



Dragged along the bottom, the spiral-bladed saw cuts off weeds in the water

Cyclist Takes Bed Along in Homemade Trailer



TOWING his sleeping quarters behind him in a compact trailer, an eighteen-year-old cyclist of Menominee, Mich., recently traveled nearly 1,200 miles to Boston, Mass., economically and comfortably. Post cards that he sold to curious spectators paid for his supplies during the fourteen-day jour-

ney. Streamline in shape, the sturdy trailer is a homemade product of his own design. He is shown above demonstrating his sleeping quarters to an admiring hotel doorman.

Odd Caddie Cart Carries Golf Bag and Clubs

ANY golfer can easily be his own caddie, with the introduction of a rolling carrier for a bag of clubs. Towed by a handle as shown below, the cart travels on rubber-tired wheels that will not mar the greens.



Here is a caddie that won't make wisecracks



Spring Loops Hold Load on Bike Luggage Rack

A HANDY new luggage carrier for bicycles makes it unnecessary to tie or strap the load in place. Twin loops of spring metal automatically adjust themselves to hold securely a parcel of any ordinary shape or size, as illustrated in the photograph above. A built-in red reflector button at the back for safety in night riding adds to the utility of the attachment.

Powerful New Lamp Lights the Invisible

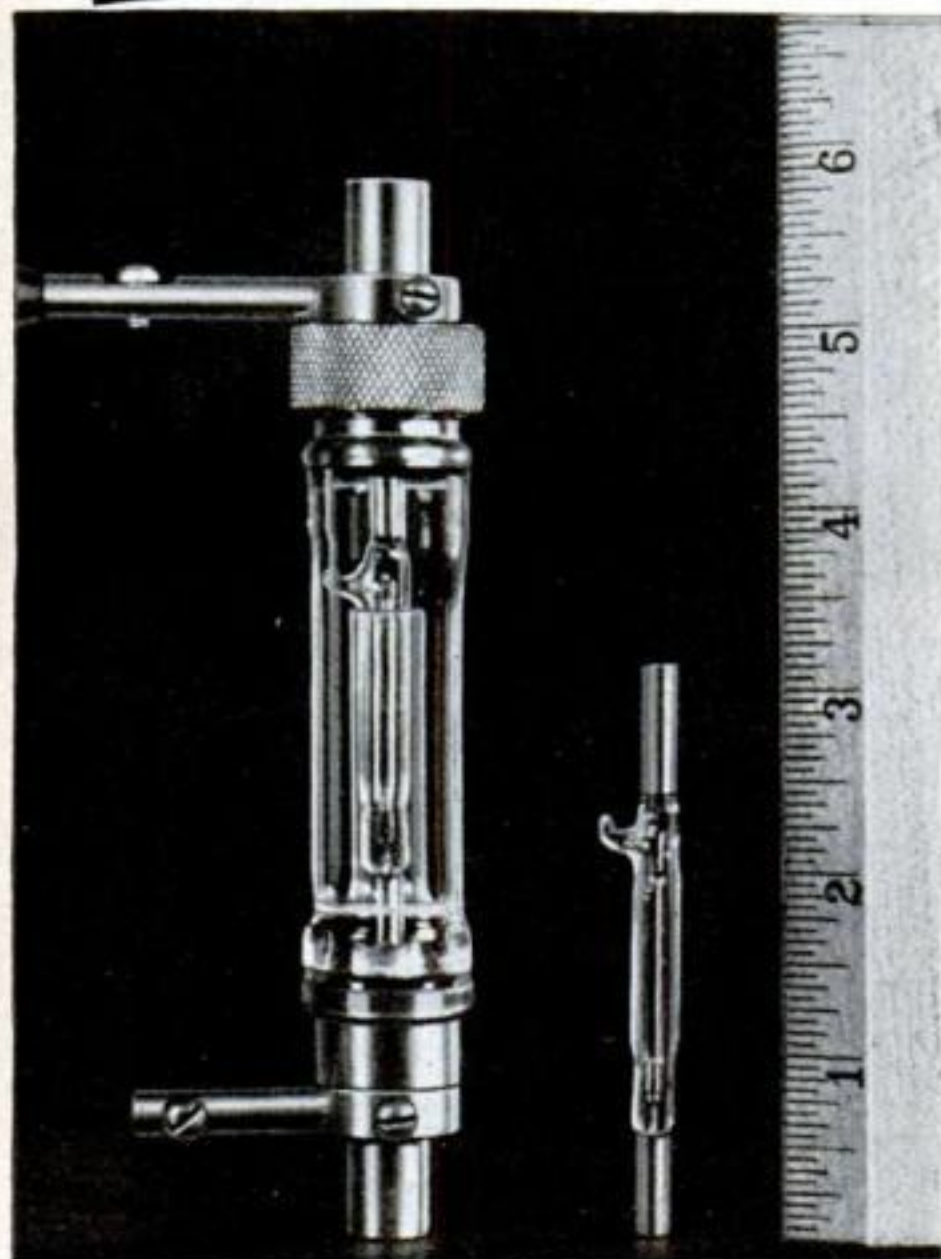


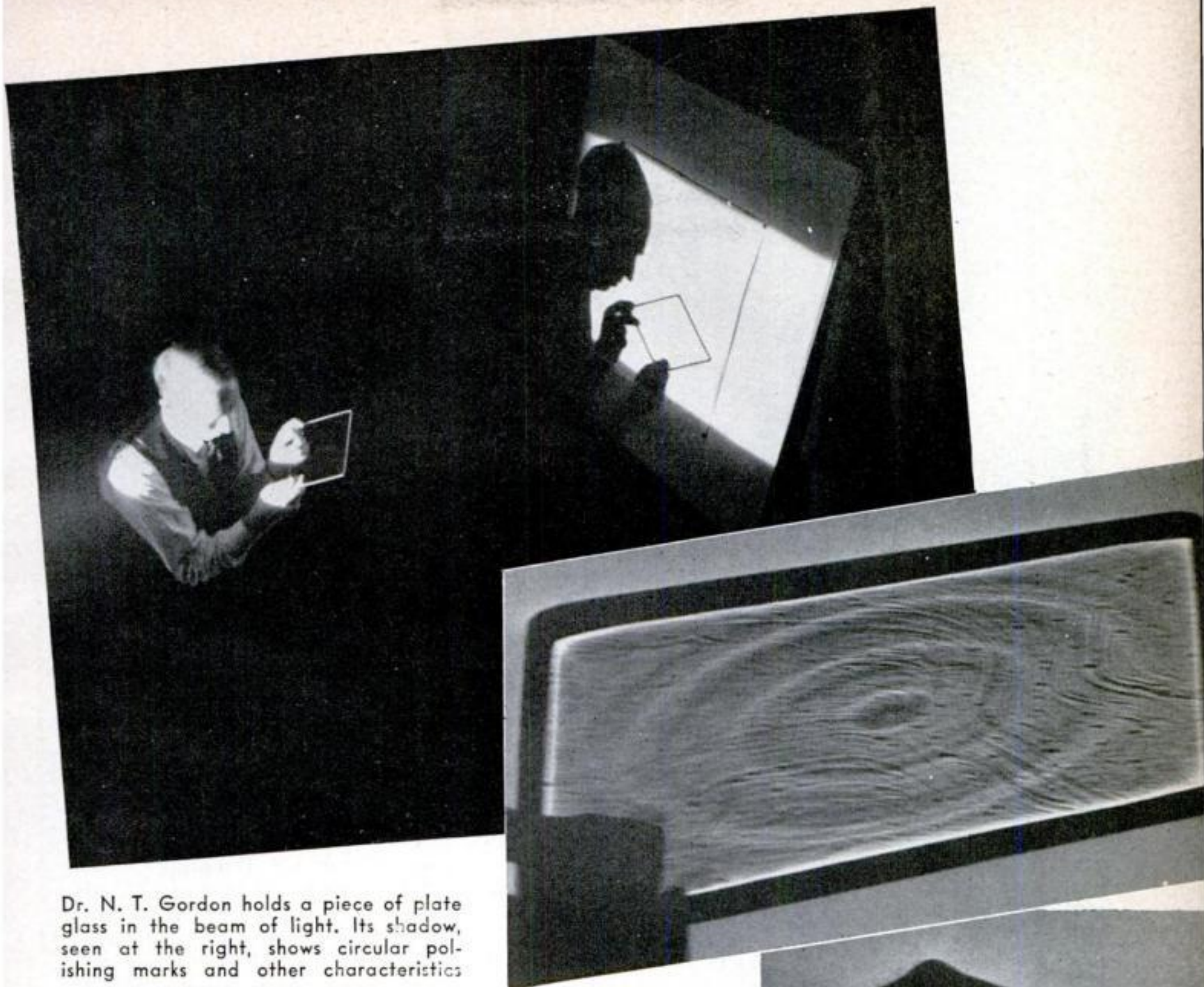
By JOHN E. LODGE

SMELLS become visible, transparent gases take shape, heat and cold can be seen with the naked eye in an amazing scientific shadow show being staged at the General Electric laboratory in Schenectady, N. Y., as a by-product of recent research with the world's most powerful electric light—a tiny, dazzling, midget sun.

An accidental discovery, a few months ago, revealed what the little lamp would do. A quarter of a mile from the laboratory in which Dr. N. T. Gordon and his assistant, Dr. R. P. Johnson, had made the final experiments with the lamp, searchlight experts were trying out one of the midget suns in a new-type reflector. Happening to glance up when the searchlight was concentrating its glare in the direction of his laboratory,

The midget arc lamp and its cooling water jacket. It is said to give out a light equal to a fifth of the sun's surface brightness





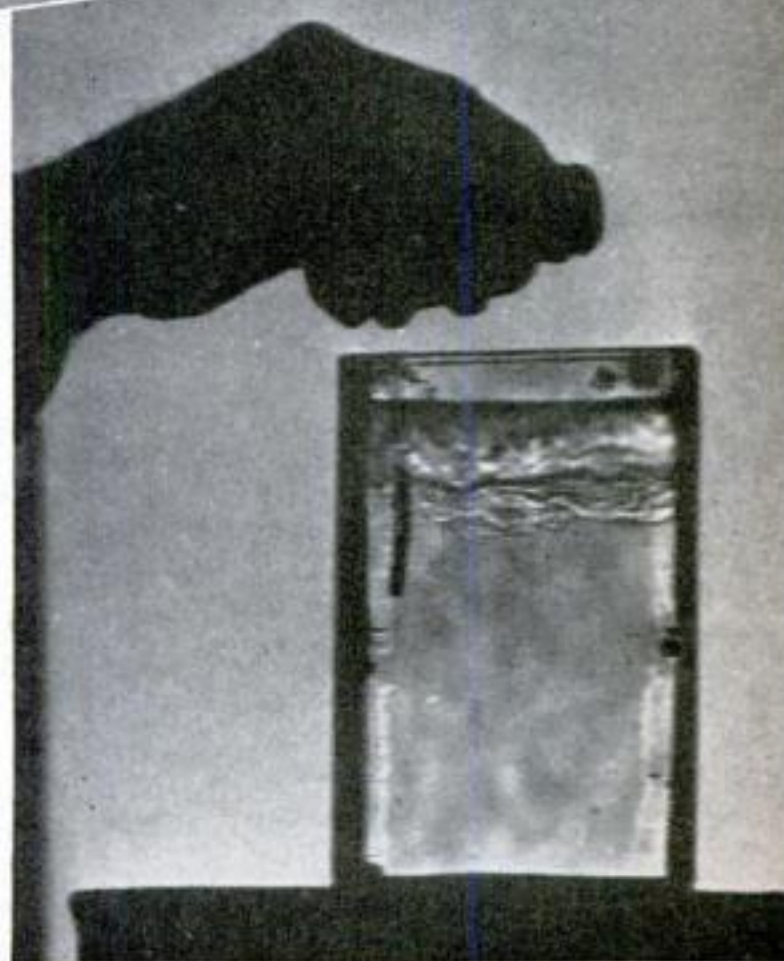
Dr. N. T. Gordon holds a piece of plate glass in the beam of light. Its shadow, seen at the right, shows circular polishing marks and other characteristics

Dr. Gordon was surprised to see curious lines of light running through the glass of his windowpane. The rays, coming from a source almost as small as a pinpoint, were revealing unseen variations in the texture of the glass.

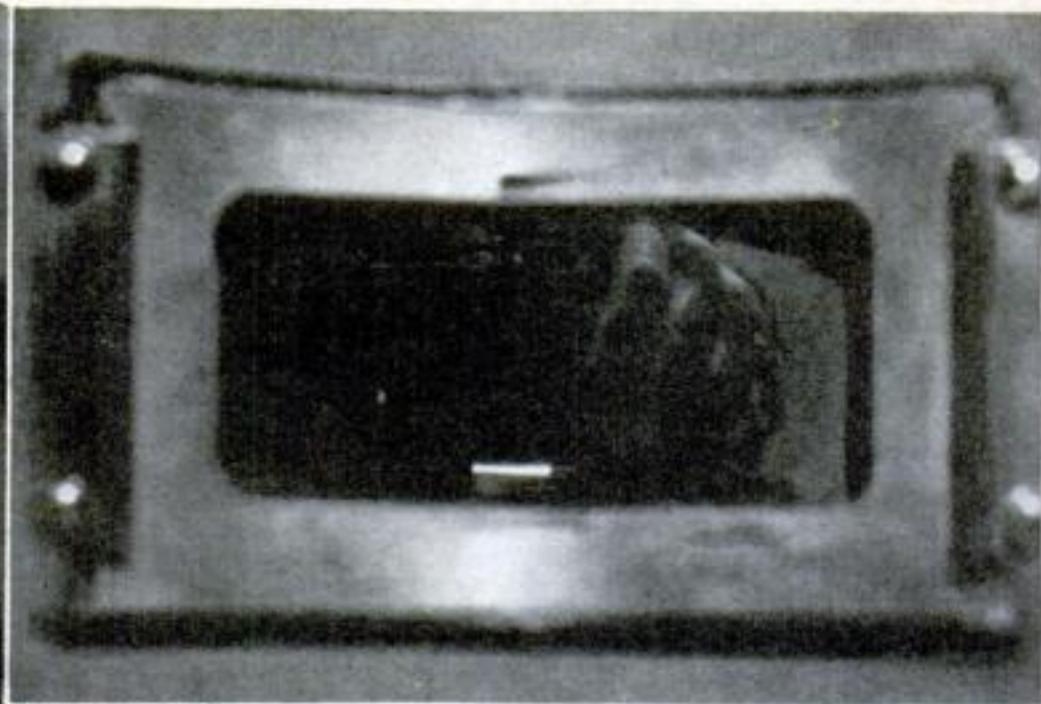
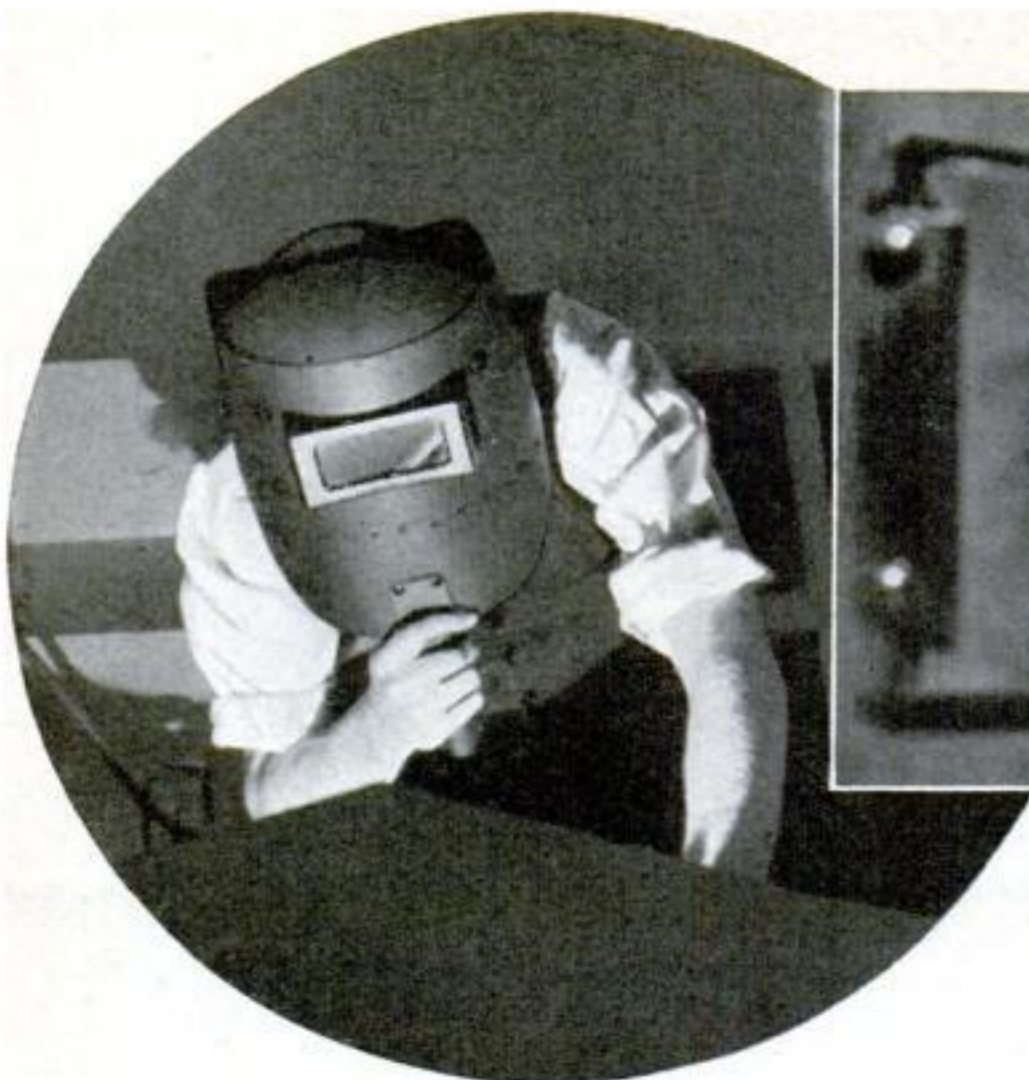
That observation started Dr. Gordon exploring the invisible by a new path. He installed one of the little lamps in his laboratory and projected the light across the room onto a white screen. When the powerful rays of the tiny lamp pass through various liquids, gases, and transparent solids, they are refracted, or bent, just enough to throw a shadow on the white screen.

Such shadows, looking a great deal like X-ray pictures, reveal the invisible in a wide variety of forms. During a recent visit to Dr. Gordon's laboratory, I watched him rub his hands together and then hold them in the path of the light. On the screen appeared the shadow of invisible heated vapor rising from his fingers. He uncorked a bottle of perfume and I could see, rising above it, a faint cloudlike image, the shadow of a smell. From a pitcher Dr. Gordon poured heavier-than-air carbon dioxide gas, and on the screen I saw it billow downward to envelop and extinguish a candle flame.

When a glass jar of water was placed in the path of the light, I was able to watch chemical reactions and the mixing of colorless fluids. Hydrochloric acid, poured



How alcohol mixes with water, as revealed by the magic shadows. Unlike hydrochloric acid, which plunges to the bottom of a glass, alcohol remains near the surface



The mask at the left is used for viewing the dazzling lamp when it is turned on. Through its darkened glass, the midget sun is just a luminous rod, as seen above

into the water, plunged to the bottom and then mushroomed out to either side. Alcohol, on the other hand, swirled about near the surface without descending. When a piece of ice was placed in the jar, a funnel of cooled, descending water penetrated to the bottom. Glass tubes, rotated in the path of the light, produced patterns—some plaid, others formed of a series of parallel lines.

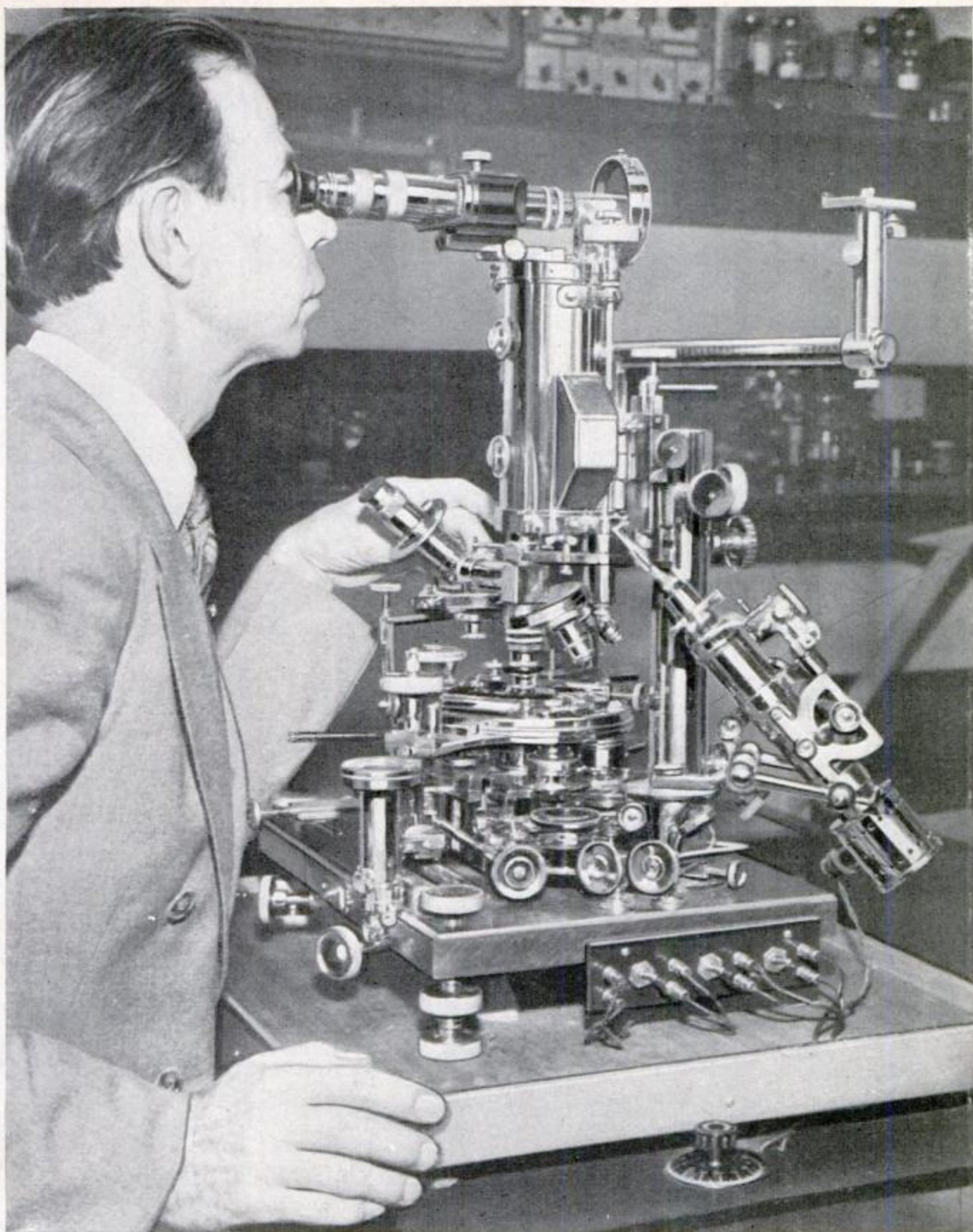
The former had been twisted during manufacture; the latter had been rolled. Other tests revealed other secrets of glass.

Dr. Gordon sees a practical application for the technique he has developed in the testing and study of glassware at factories. Another field where it may find widespread use is in teaching. Through such scientific shadow shows, students will be able to see with their own eyes chemical reactions and other scientific occurrences which hitherto have been invisible.



Shadows paint a picture of invisible carbon dioxide gas pouring from a pitcher to put out a candle flame. At the right, a cold stream flows down from a lump of ice in a jar of water



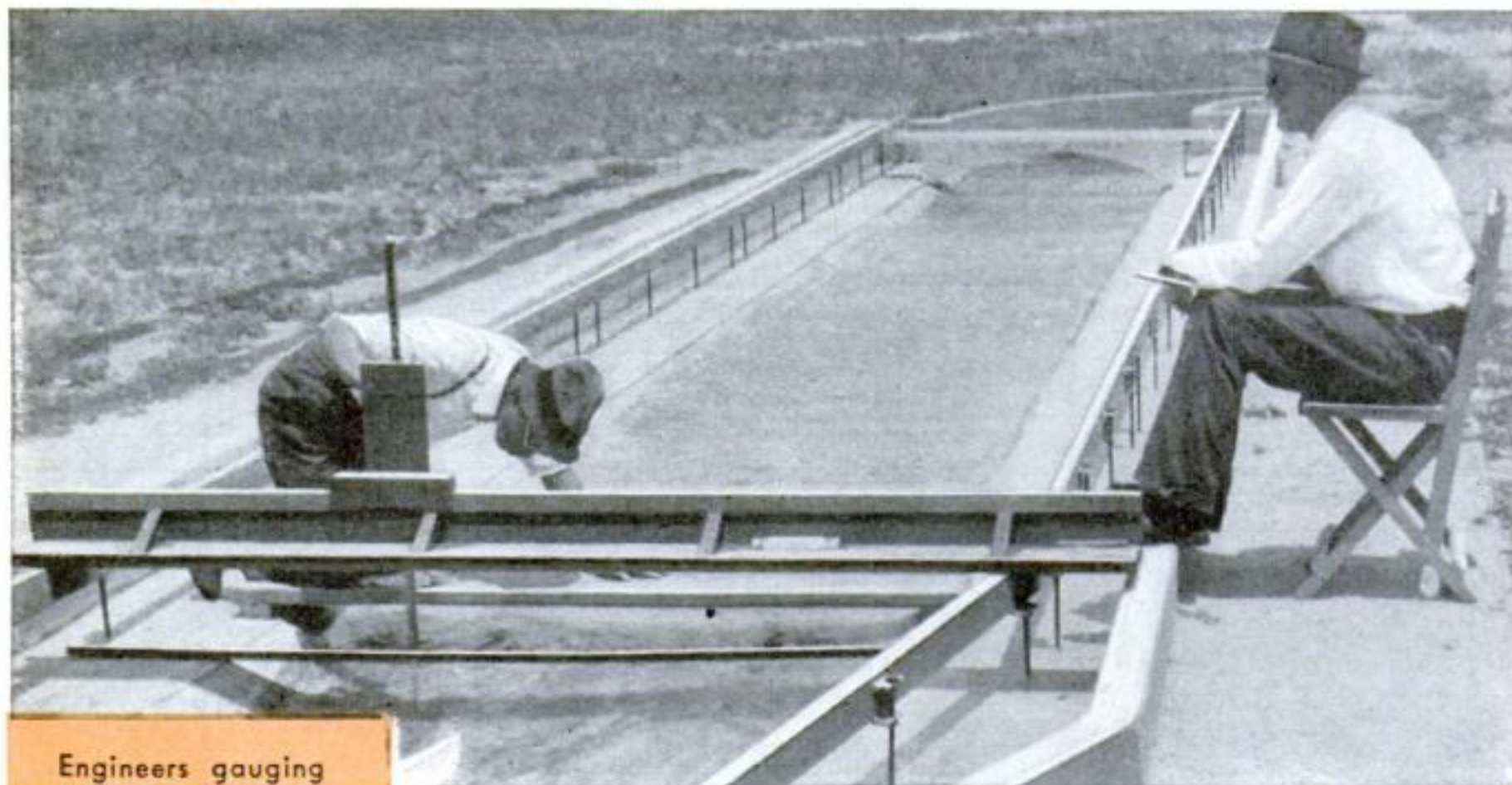


Giant Microscope Explores New Worlds

REPORTED to be so powerful that it reveals disease organisms never seen before, the giant microscope pictured above has just been completed by Royal R. Rife, of San Diego, Calif., whose home-built instruments have long been ranked among the finest in

the world. To eliminate distortion, the image produced by the new two-foot-tall apparatus does not pass through the usual air-filled tube, but along an optical path of quartz blocks and prisms. Weighing 200 pounds, the microscope has 5,682 parts.

Fighting Floods on



Engineers gauging surface elevations on the scale model of the Los Angeles River in a city park

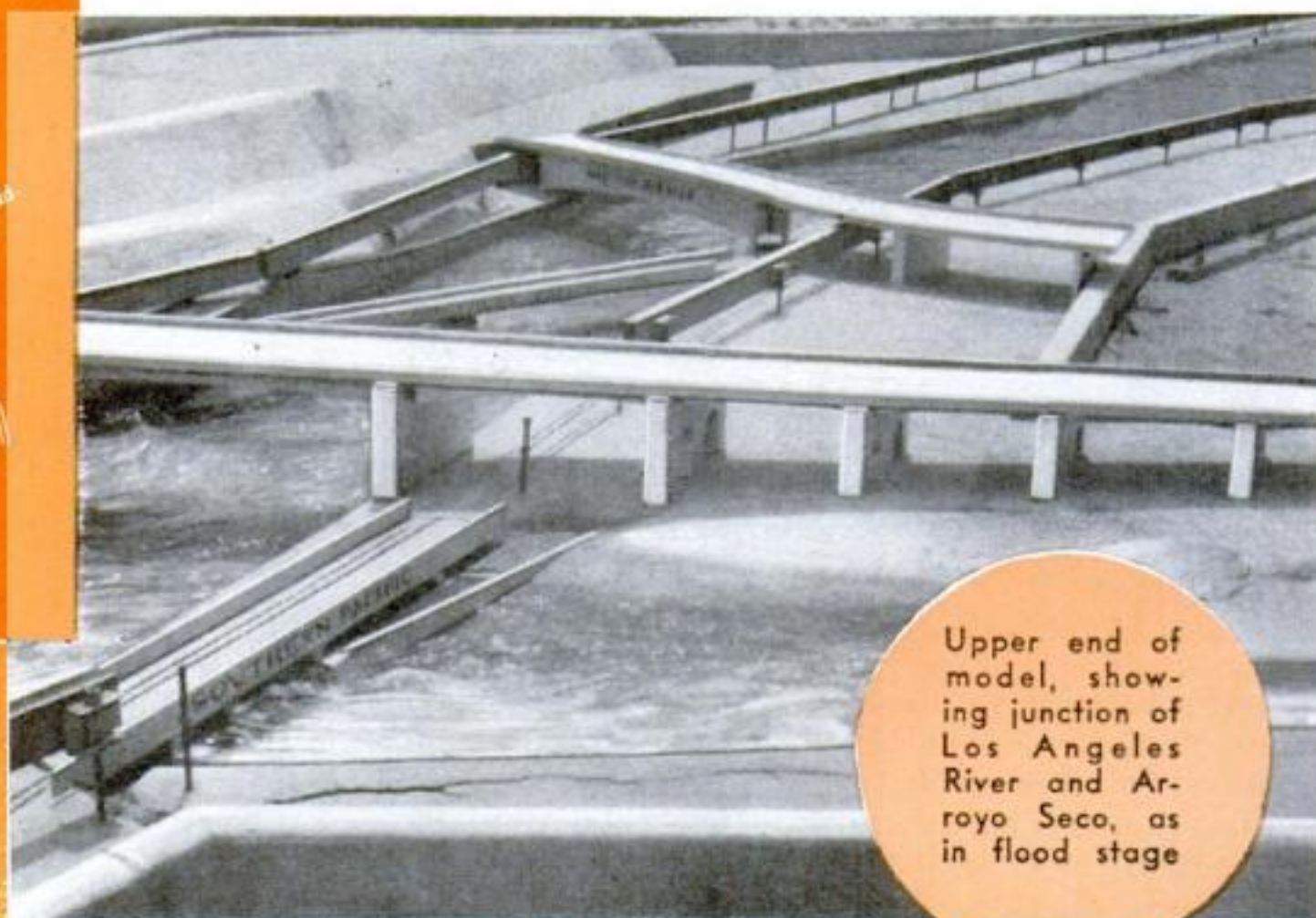
By C. W. WATERMAN

BRIDGE PIERS of novel, streamline design will let river floods rush smoothly past, averting dangerous and costly washouts. How to shape them has been learned by U. S. Army engineers during a year of experiments with a 385-foot model of the Los Angeles River in California.

Accurately constructed to scale in one of the city's parks, the model represents a four-mile section of the river passing through metropolitan Los Angeles. Along this stretch, thirteen bridges and trestles span the stream, which is bordered by rail-



A map of the section of the river being studied. Note many bridges



Upper end of model, showing junction of Los Angeles River and Arroyo Seco, as in flood stage

a Miniature River



Wedge-shaped pier extensions, represented by the portable model seen above, were found to reduce flood level

Water piles up against a common rounded pier, while sliding quietly past a streamline one

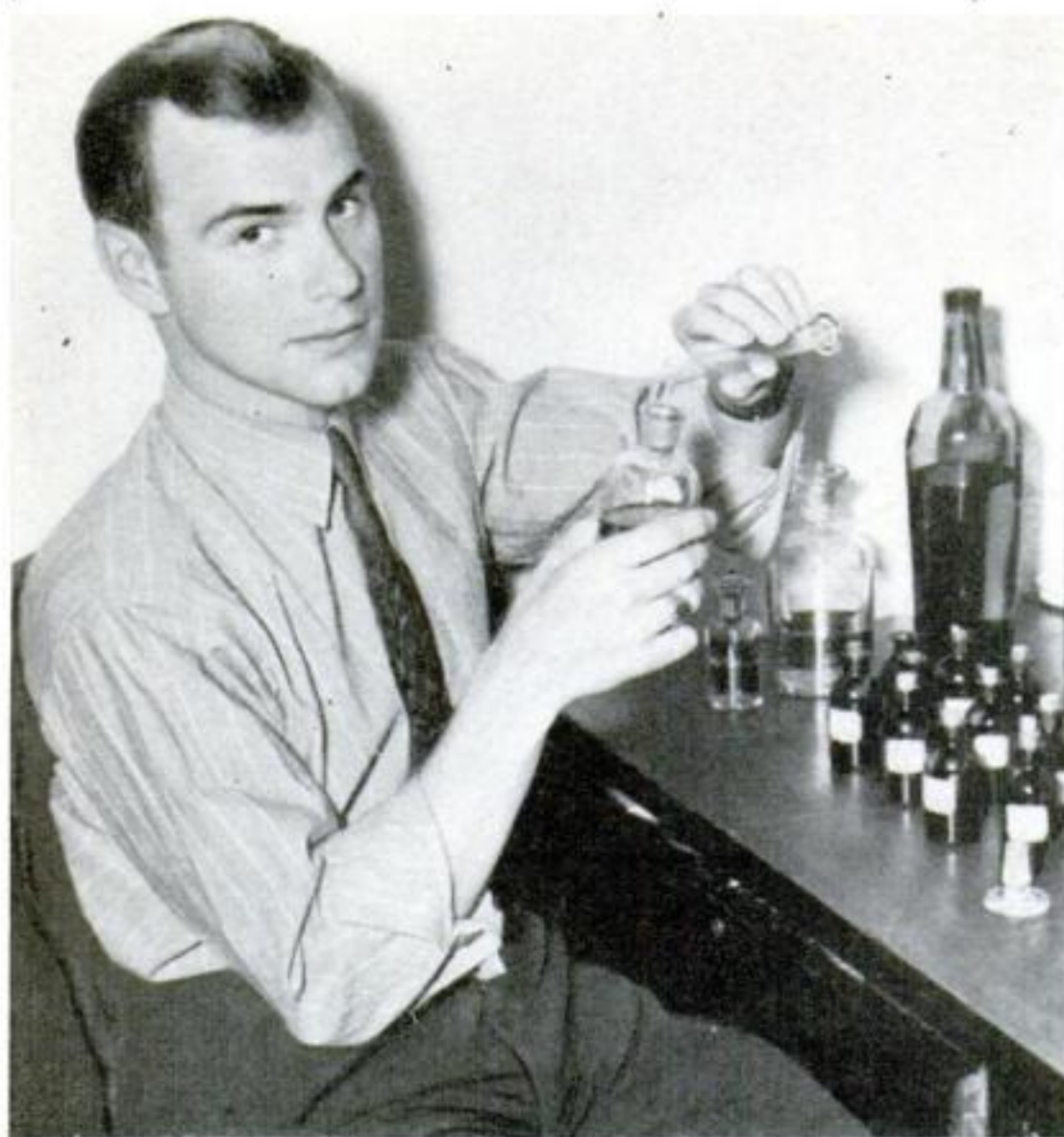


road tracks on both sides. A tributary, the Arroyo Seco, adds to the flood problem. Both channels, bone-dry beds of sand for a part of the year, seasonally carry vicious torrents from near-by mountains to the sea. In the model, artificial streams faithfully reproduce the seething currents in miniature.

Because obstructions in the stream determine the height for protective channel walls, the engineers have concentrated their attention upon the forest of bridge piers in the district. On the upstream side of a span, the trouble is "backwater"—flood water that piles up first against the semicircular faces of the piers, and then against the

bridge itself, often washing over it. This requires high channel walls to prevent overflow. At the downstream side of a bridge, similar pier faces set up large waves, topping a bank that otherwise would be high enough.

Simply by adding wedge-shaped extensions to streamline both faces of a pier, all three difficulties are eliminated, the engineers have found. When a portable model of the novel fairing is held against a miniature bridge, churning waters are magically quieted. With a wealth of such new data, the engineers are developing a complete flood-control plan for the vicinity.



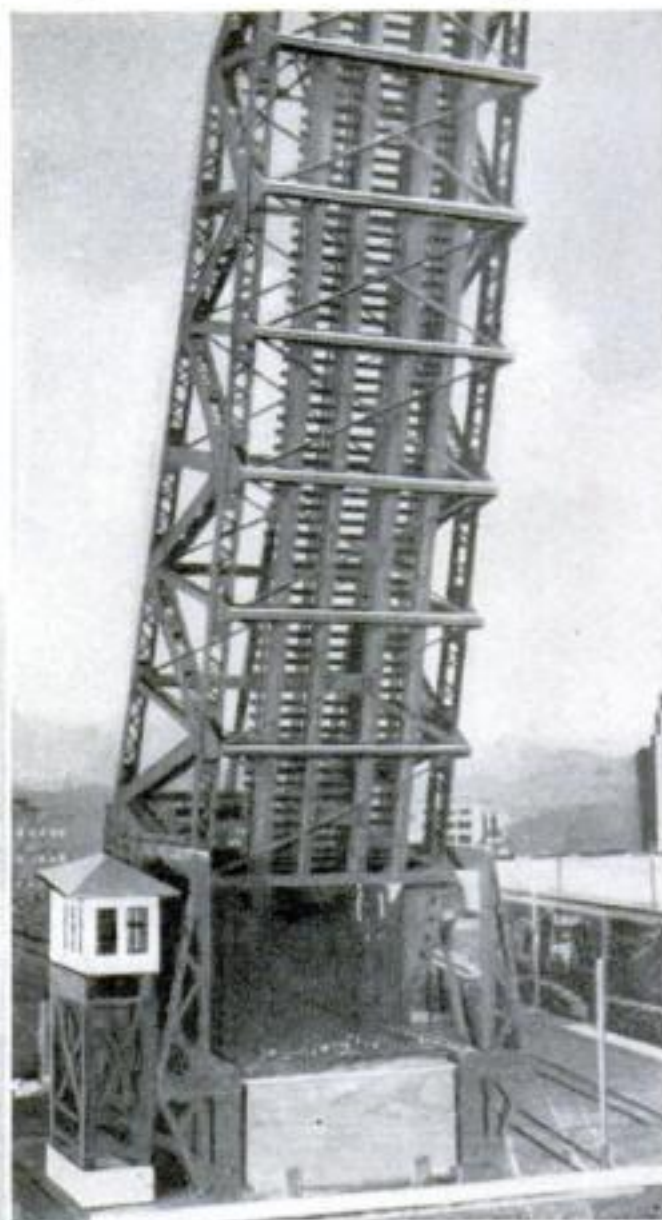
Robert Maiden mixing chemicals to produce perfumes for sale

Perfumes Help Pay Chemistry Fan's College Expenses

GETTING a college education is a matter of scents as well as of dollars and cents to Robert Maiden, of Palo Alto, Calif. When he was casting about for a way to defray part of the cost of a business course at Stanford University, Maiden, now a sophomore, decided to make capital of his hobby of chemistry. He therefore worked out a selection of chemically produced perfumes, which he now concocts himself for sale to campus co-eds and to local shops. So successful has the venture become, that Maiden may have hit on a full-time money-making career which will be in a thriving state by the time he puts his books aside at the end of his college course and starts in to earn a living.

Model Railway Gets Rolling Lift Bridge

MORE than 32,000 rivets were employed in the construction of the remarkable model-railroad bridge pictured below and at the right. Modeled after the Scherzer rolling lift bridge that carries trains of the New York, New Haven, and Hartford Railroad across the Housatonic River at Devon, Conn., the scale bridge represents three years of spare-time work on the part of Alfred Schellbach, of New Haven, Conn. Tipping the scales at fifty-eight pounds, the span is thirty-seven and a half inches long, the scale equivalent of 150 feet. The bridge has been put into service in the miniature-railway system of the New Haven Society of Model Engineers.



Two views of the model rolling lift bridge. Counterweights raise it to open the span as illustrated above



Orchids on a Window Sill

HOBBYIST RAISES RARE TROPICAL FLOWERS



Peter Rolph spraying water onto the orchid plants in his window-sill garden to maintain the proper humidity. At left, one of the exquisite blooms



growers advised against the project, Rolph, a restaurant manager, bought a single five-dollar plant as a starter less than two years ago. Now he has thirty-five healthy orchid plants that insure, among them, at least one exquisite bloom at all times. So far, he has lost only a single plant.

Rolph knew that orchids in their native tropical habitat thrive on an atmosphere high in moisture content. To assure the plants of sufficient humidity, he placed them in special pans of nonrusting metal and set them on top of a corner radiator grill. Sheets of asbestos in the pans soak up and maintain the required moisture, while thermometers and humidity gauges in each pan help Rolph keep an accurate check on atmospheric conditions. A special oil-silk curtain masks the windows adjacent to the orchids to shield them from

AN ORIGINAL investment of five dollars, months of painstaking care, and a generous sprinkling of real ingenuity have made a success of Peter Rolph's hobby of raising costly and delicate orchids on a window sill of his New York City apartment. Although professional

the direct rays of the sun, while still affording them the abundance of light they require.

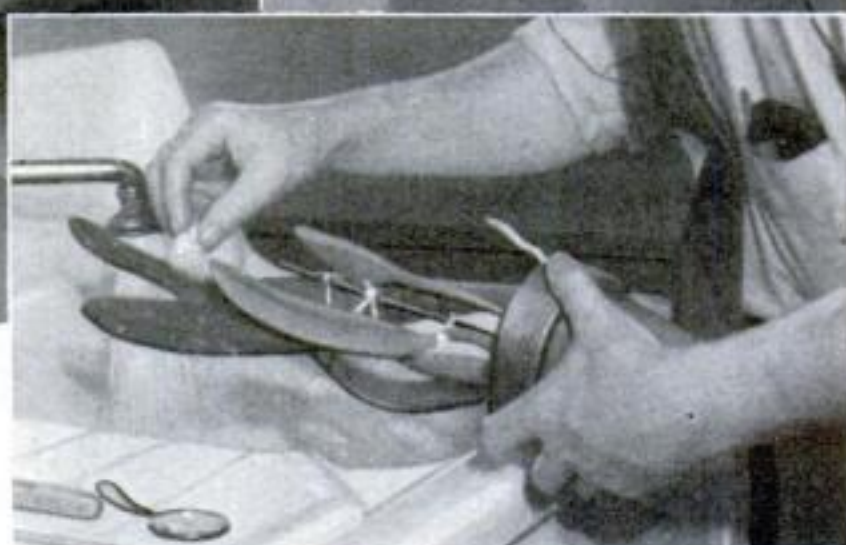
Containers used for the plants are ordinary flower-pots. In the bottom of each are placed some pieces of broken pottery covered with a layer of sphagnum moss. The loose pieces prevent the moss from packing down too tightly, and also assure a free circulation of air around the plant roots.

Humidity is maintained between forty and sixty percent, and the temperature between seventy and eighty degrees F. Whenever humidity shows signs of falling below the danger point, the hobbyist goes to work with a spray gun full of water. One of the secrets of his success, Rolph believes, is the fact that he gives constant and unfailing attention to each plant. Once a week he examines every plant leaf for signs of insect pests or blights of one kind or another. Each leaf is swabbed clean with a silk sponge, and then the entire plant is washed under a fine spray.

Probing the plant roots and, at right, brushing off insect pests



Orchids get a weekly bath in the kitchen sink with a sponge of silk, as at the right



In a number of the species that he grows, the orchids may be propagated by subdividing. By removing the separate root growths and placing them in individual pots, new plants are started as desired.

Surfboards from P. S. M. Sail Swiss Lake



SURFBOARDS in Switzerland may seem out of place—but actually they're great sport. Constructed from plans published in this magazine (P. S. M., June, '39, p. 174), the versatile craft serve for paddling races and as sailboats for two Swiss enthusiasts. A bicycle-wheeled cart transports the boats to and from Hallwyl Lake. Illustrations below show one of the hollow surfboards before completion, and the finished pair.



Surfboards on Hallwyl Lake, Switzerland. One of the hollow craft, built from P.S.M. plans, is seen under construction at left

Twin Motors Run Giant Model Airplane

A GIANT in its class, a model airplane owned by Orin Anderson, of San Antonio, Tex., is propelled by twin motors placed one above the other. Originally constructed by an airplane mechanic at the U. S. Army Air Corps training center at Kelly Field, Tex., the monoplane was designed to be controlled in the air by radio. When that idea was abandoned, Anderson acquired the ship in trade for model parts, and now flies it as an ordinary model airplane with the controls fixed in one position.



It takes two tiny gasoline engines, one mounted above the other, to propel the oversize plane model shown in the air at the right

Jeweler Collects Finger Rings

COLLECTING old and rare finger rings is the interesting hobby of Charles Harris, a New York City jeweler. Among the many items in the collection are a bronze ring made for Napoleon Bonaparte from captured Russian cannon, a gold ring containing a sharp steel knife blade that springs out at the touch of a button, and an ancient poison ring set with an emerald and two rubies. The latter ring has a hollow band designed to contain a liquid poison. Pushing one of the gems causes a poison-coated pin to jut out from the ring band. Harris's father started the collection fifty years ago.

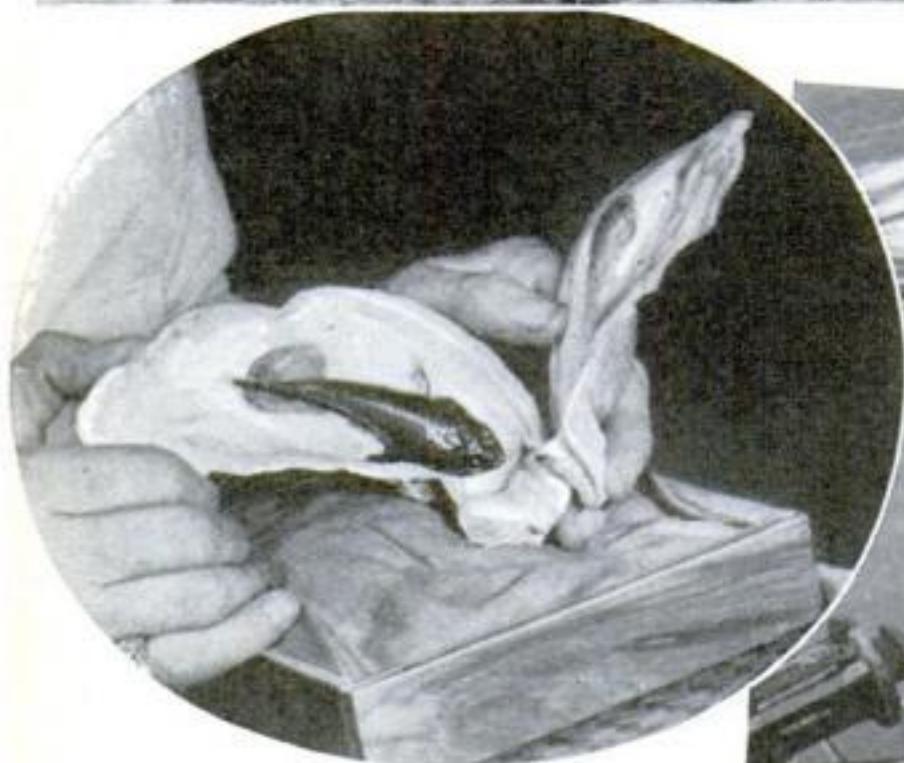


Rare old finger rings in the collection of Charles Harris, of New York City, seen above examining a ring made for Napoleon Bonaparte from captured cannon. The ring in inset conceals a sharp steel blade

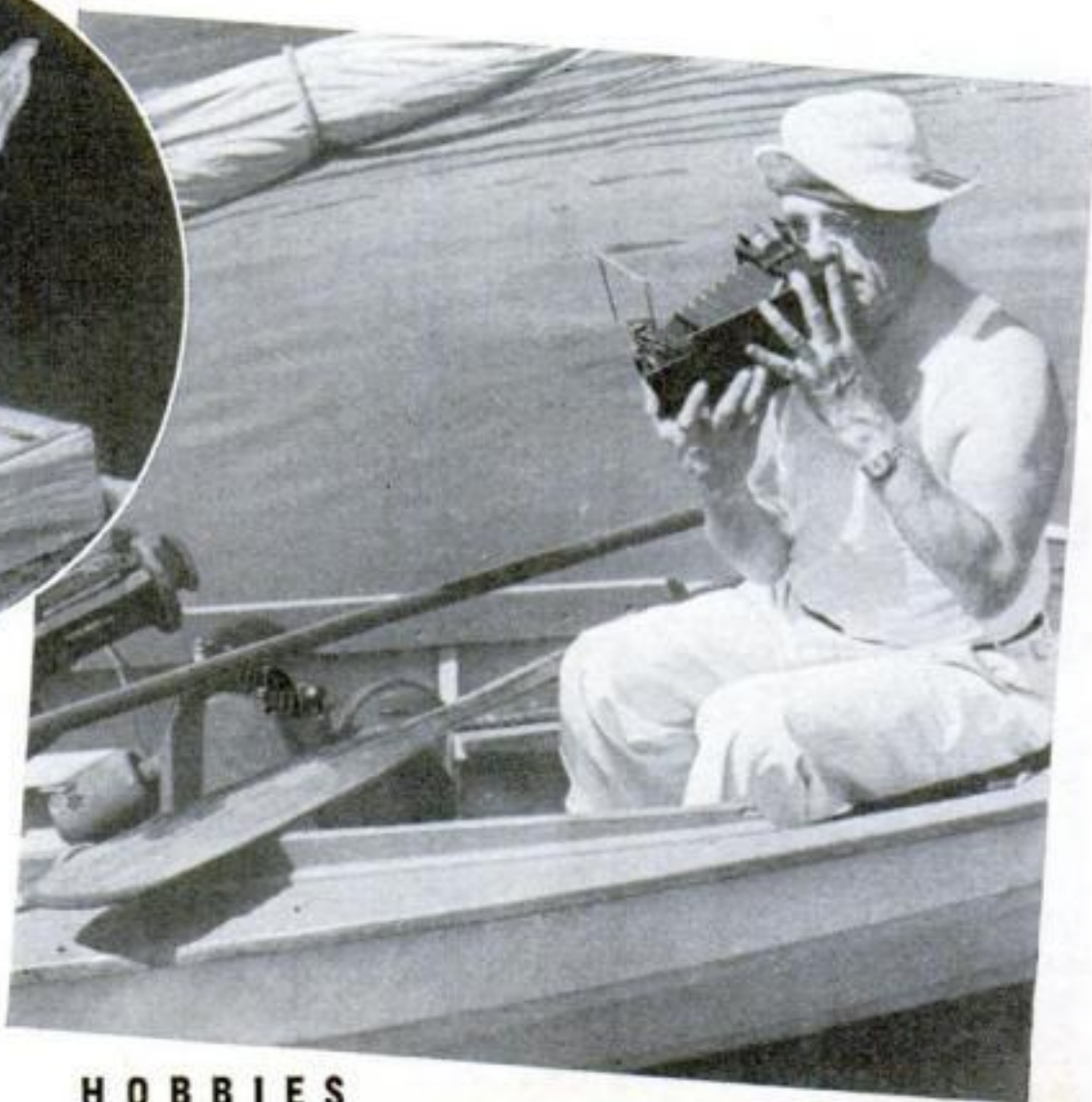
Globe-Trotter Collects Curios



JUNKETING around the world for curios, with plenty of time and means to enjoy his hobby, Harold W. Smith has acquired an almost unbelievable collection for his Oceanside, N. Y., summer home. While he was at an oyster bar in a Richmond, Va., hotel, he relates, an oyster was opened and a live, sizable fish jumped out. Smith obtained the fish and shell, and had them mounted together. Another of his prized oddities, a disk-shaped rosette of lead from a Civil War battlefield, is said to have resulted when a Union bullet and a Confederate bullet chanced to meet head-on in mid-air! Hundreds of such strange objects as Zulu carvings, a stone footprint of a prehistoric raccoon, and copies of the world's fifteen most famous diamonds fill his museum. His adventures on collecting trips include a descent into Vesuvius, a ship mutiny, a visit to African gold fields, and a trek across Argentine pampas to the Andes.



A fish found alive in an oyster shell is one of the oddities in the big collection of Harold W. Smith, of Oceanside, N. Y. At the right, the hobbyist is seen photographing a curiosity discovered on his travels; at top, with part of his private museum





Radio Amateurs Get Tower Clubhouse



Manchester, N. H., "hams" in the operating room of their city-owned radio station, located in the old tower seen at the left

CONVERTED into an up-to-date radio station, an old stone observatory at Manchester, N. H., now serves a threefold purpose. As a public facility of the city, its short-wave outfit has been turned over to amateur radio enthusiasts, who have formed a club to share its use. If an emergency such as a flood or hurricane cripples other communications, the station will keep Manchester in touch with the rest of the country. In the course of adapting the venerable

landmark for these practical purposes, it has been renovated and preserved as one of the city's historical points of interest.

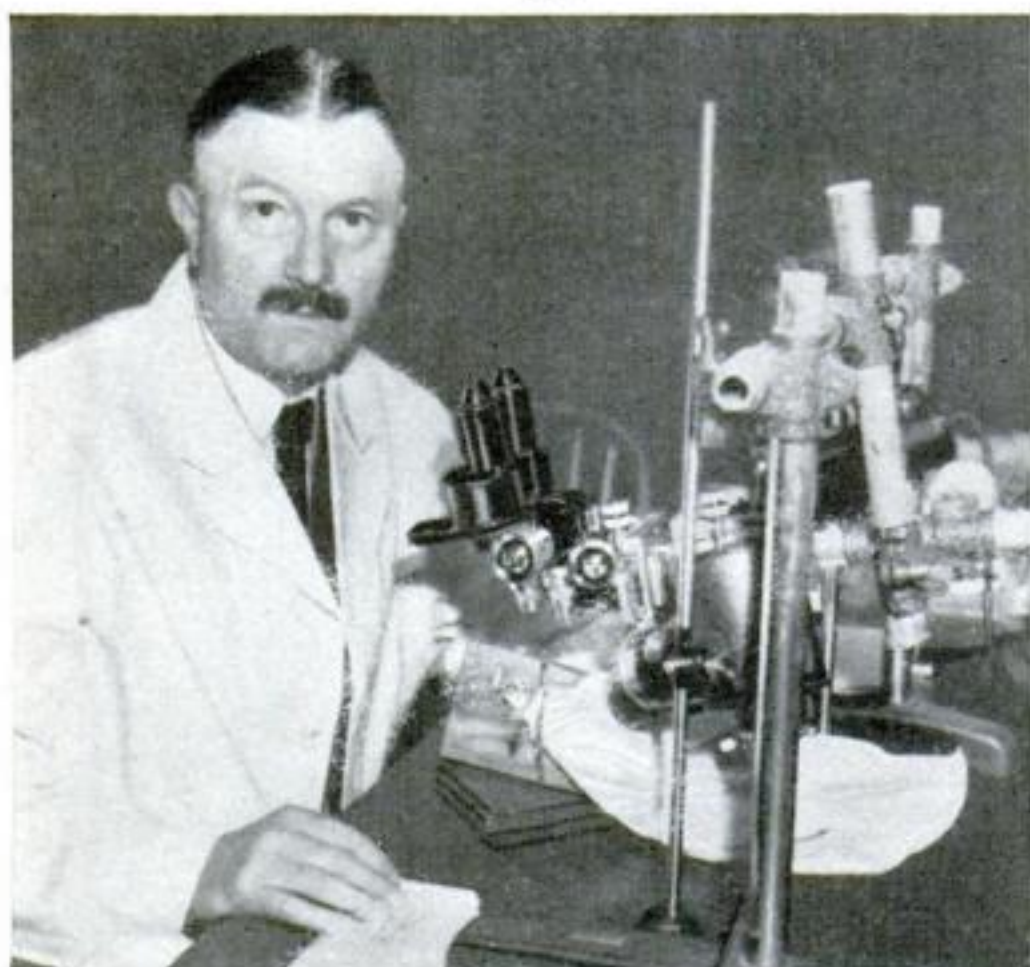
The first floor, attractively furnished as a reception room for visitors, also does duty as a clubroom for the radio "hams." Their station, with call letters W1LVK, occupies the second floor. Its powerful transmitter and receiver cover all amateur frequency bands. In case city power should fail, a three-kilowatt, gasoline-driven generator will operate the plant. The top floor of the tower houses a workshop and experimental laboratory, and three sixty-foot poles, supporting an antenna, complete the installation.

Built by a former governor of New Hampshire, the round tower was recently presented with its grounds to the city. Public officials and leading citizens devised the novel plan of putting the relic to use, and their scheme was carried out with Government aid as a W.P.A. project. The eleven-acre grounds surrounding the tower have been made into a public park.



The reception room on the ground floor also serves as a clubroom

Tests on Frogs Show How Cancer Spreads

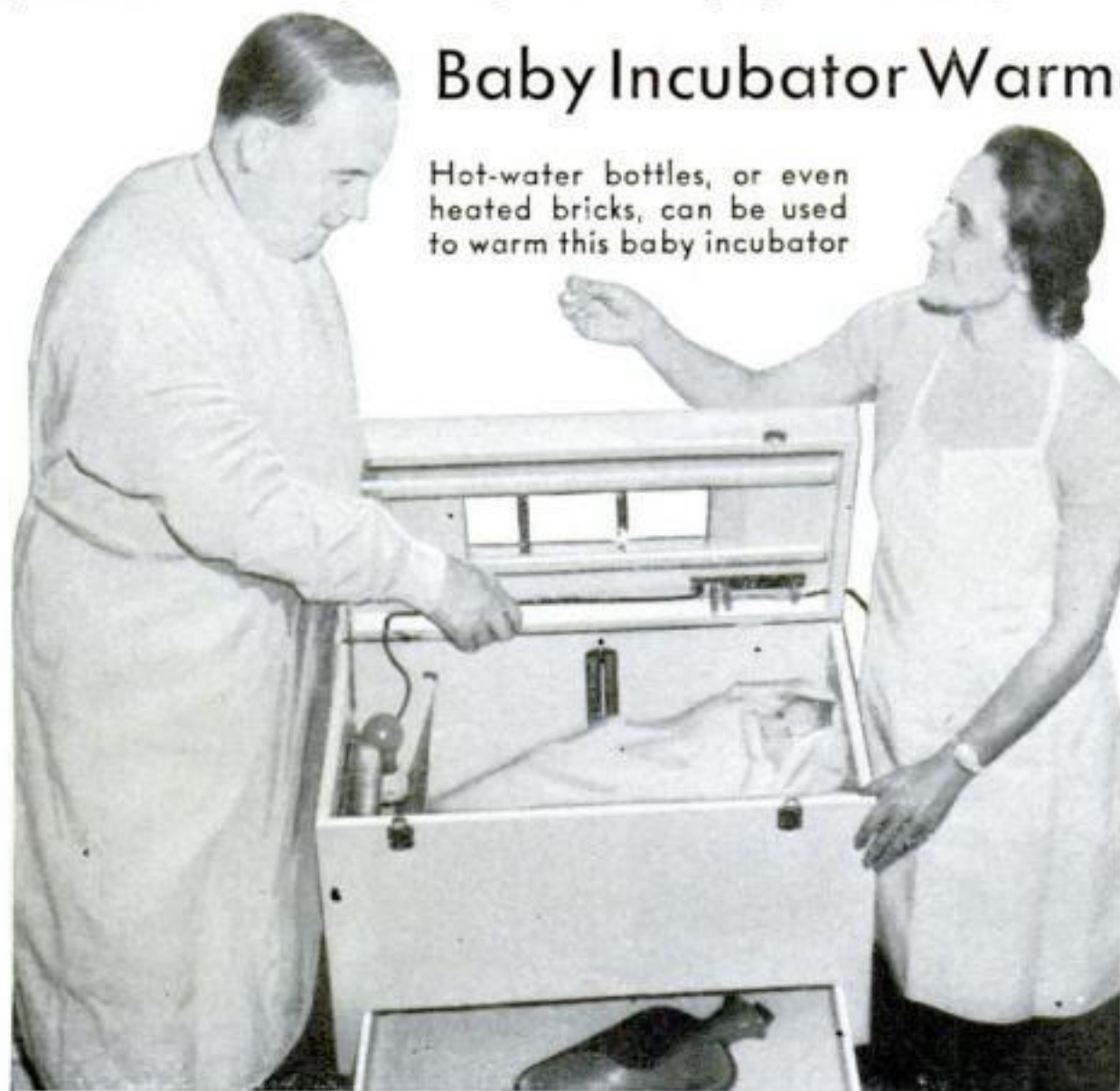


Dr. Baldwin Lucke in his laboratory. At right, a frog under the microscope, and a highly magnified photograph of its eye tissue infected with cancer



BY TRANSPLANTING malignant cancer cells to the eyes of frogs, Dr. Baldwin Lucke, University of Pennsylvania pathologist, has found a promising new way to study their growth in normal tissue. Periodic observations and photographs through a powerful microscope clearly show the prog-

ress of the disease in his animal patients. Resulting data may eventually prove useful in the treatment of human sufferers. Already the tests are reported to have revealed well-defined patterns, previously unknown, in the spread of cancer.



Hot-water bottles, or even heated bricks, can be used to warm this baby incubator

Baby Incubator Warmed with Hot Bricks

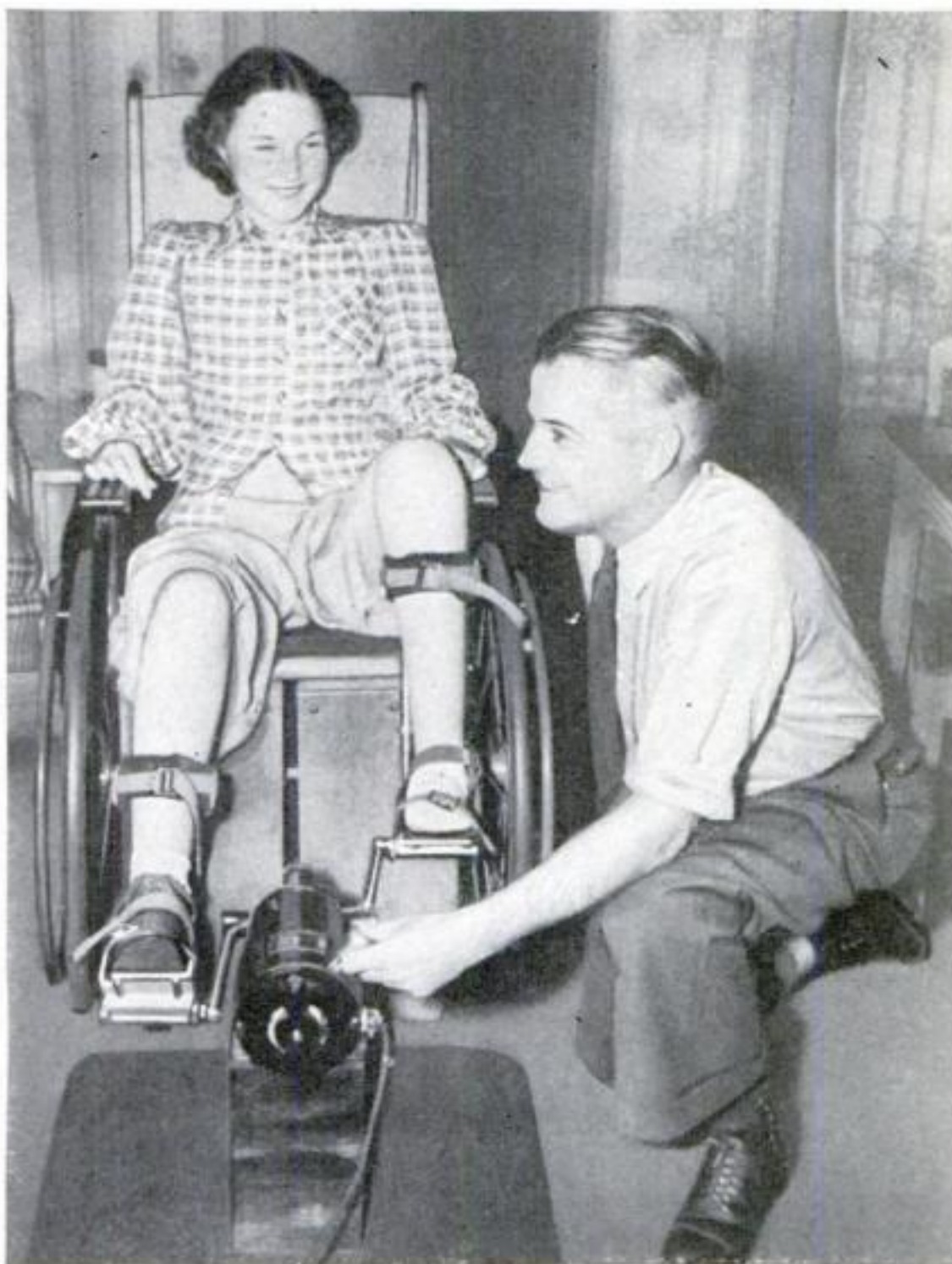
DESIGNED to serve equally well in primitive or modern surroundings, a baby incubator of novel plan has been built by National Youth Administration boys as a health project for Chippewa County, Wis. Where current is available, the chamber is heated with electricity, regulated by a rheostat to give just the desired degree of warmth. In rural homes where electricity is lacking, the incubator is kept warm by placing hot-water bottles, hot bricks, or heated sandbags in a bottom drawer. A thermometer, visible from the outside, shows when it is time to renew the supply of heat.

Arteries Sewed with Sugar Rods as Darning Eggs

RODS of sugar may serve as "darning eggs" for sewing together the ends of ruptured blood vessels, one of the most delicate of surgical operations. After fulfilling its purpose, the sugar would harmlessly dissolve. Proposed by Sidney Smith, Jr., University of Chicago medical student, the method is reported to have proved successful in preliminary trials upon animals. Below, Smith demonstrates his idea on a cut rubber tube.



Sidney Smith, Jr., demonstrates his method of sewing up blood vessels



Exerciser for Paralysis Victims

AFTER building seventy-eight experimental machines to aid victims of infantile paralysis, two brothers of Los Angeles, Calif., have perfected the electric exerciser shown above. Legs and feet of the patient are strapped to pedals like those of a bicycle, which are revolved in either direction by a reversible electric motor.

Odd Service Brings Movies to Patients

A WOMAN invalid's desire to see movies of the New York World's Fair suggested a popular and profitable service to a New York motion-picture operator. Now he brings his projector to bedridden patients, entertaining them with film dramas or with travel pictures of places they would like to be able to visit. For children, his repertory includes animated cartoons.

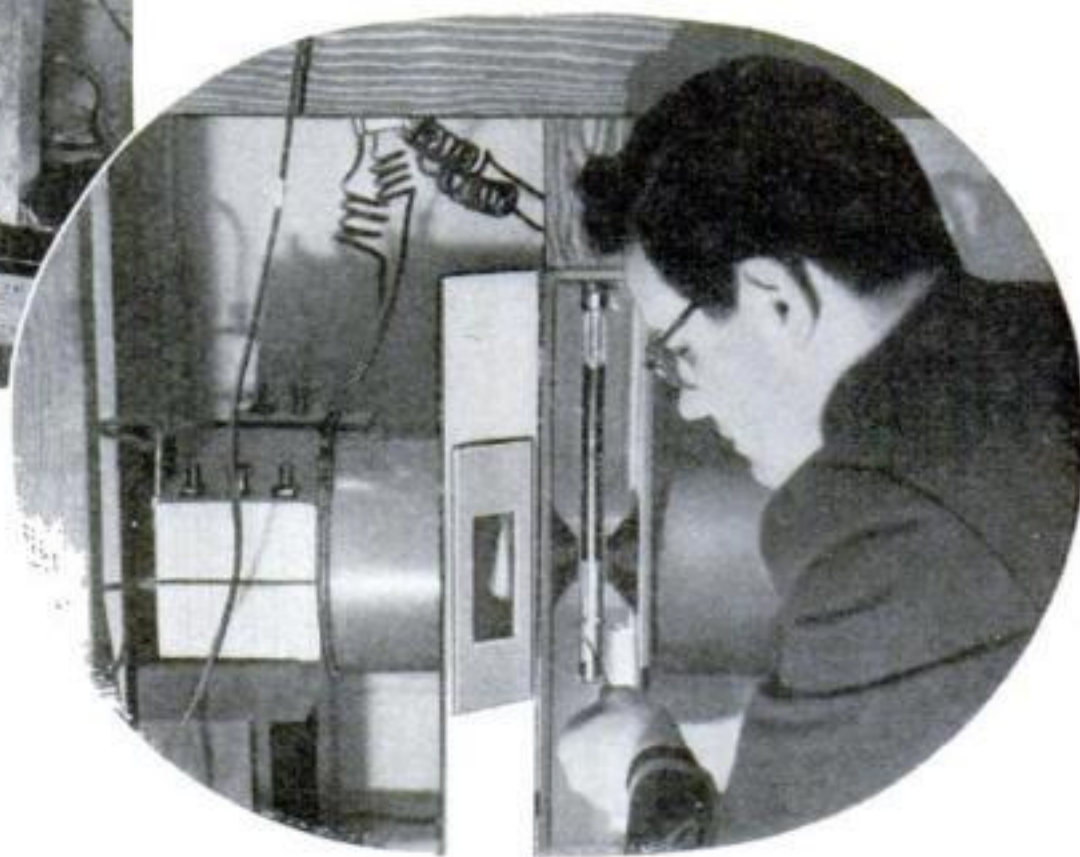


Magnetism Provides New Tests of Blood



Dr. C. D. Coryell with the apparatus used in magnetic blood tests. Right, blood sample between poles of the electromagnet

BLOOD has surprisingly been found a magnetic substance, by Dr. C. D. Coryell of the University of California at Los Angeles. Suspended between the poles of an intensely powerful electromagnet, a tubeful of bright-red blood from the arteries is repelled. Dusky-colored blood from the veins is attracted. Samples affected by carbon monoxide, cyanides, and other toxic agents differ in strength of attraction or repulsion, which may be measured with delicate scales. This "chemical analysis by magnetism" offers a promising new way to study life processes and methods of combating poisons. So far Dr. Coryell has tested twenty-five gallons of beef blood, and also some of his own.



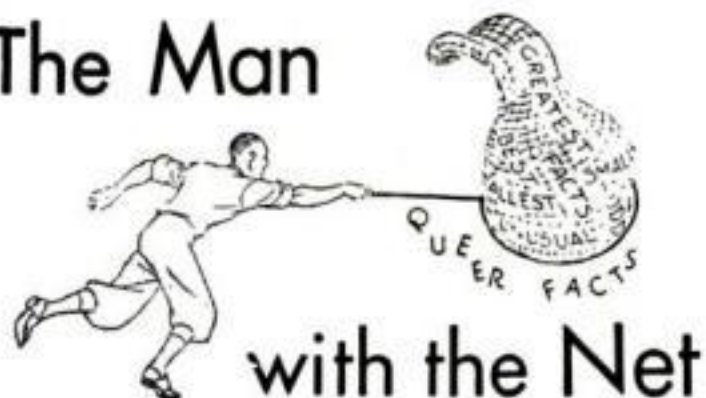
Multiple Electric Vibrator Massages the Scalp

FOUR hundred and eighty artificial fingers give the scalp a gentle and beneficial massage, in a multiple electric vibrator just introduced. Light in weight, the appliance may easily be self-manipulated as at left, with the aid of two convenient hand grips, while four vibrating disks do their work in unison. The machine is said to stimulate the circulation of blood to scalp and brain cells and to remove all dandruff and loose hair.



Using the new vibrator. Inset shows four disks

The Man



with the Net

PHOTO-ELECTRIC cells are used in a new device which is said to detect the approach of death by color changes in the skin.

AUSTRALIA'S Great Barrier Reef has an area twice that of the State of Ohio.

SWALLOWING occurs involuntarily in humans about once a minute.

NINETY-FIVE PERCENT of all the bathtubs in the world are in the United States.

GOSH, WE
CAN'T BE
THAT
DIRTY!



BEEES, roasted in oil and rubbed on the head, once were thought to prevent hair from turning gray.

NATIONAL FORESTS comprise almost one tenth of all the land in the United States.

REINDEER MILK is richest of eleven types listed by the U. S. Department of Agriculture.

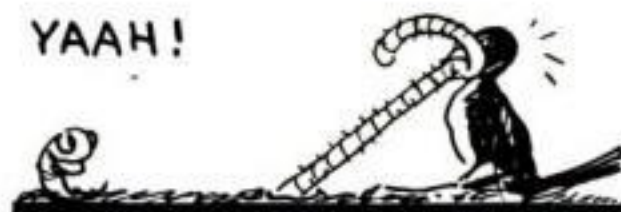
SO WHAT?



CURLING tendencies in papers are now measured by experts at the U. S. Bureau of Standards.

EARTHWORMS have 900 bristles on their bodies with which to anchor themselves in the ground when birds try to jerk them from their burrows.

YAAH!



Fish "Talks" on Radio

A TALKING CATFISH startled listeners to a recent broadcast from a New York City radio station. When removed from his tank in the Staten Island, N. Y., zoo, the conversational catfish, a native of the Amazon region of South America, made curious sounds into the studio microphone as part of a natural-history program.

Tree Serves as Cellar

MAINTAINING a temperature between forty and fifty degrees F. the year 'round, the hollow trunk of a huge maple tree serves as a fruit-storage cellar for a Redmond, Wash., family. The tree cellar has room for 400 quart fruit jars.



Preserved fruit is kept cool in this hollow tree



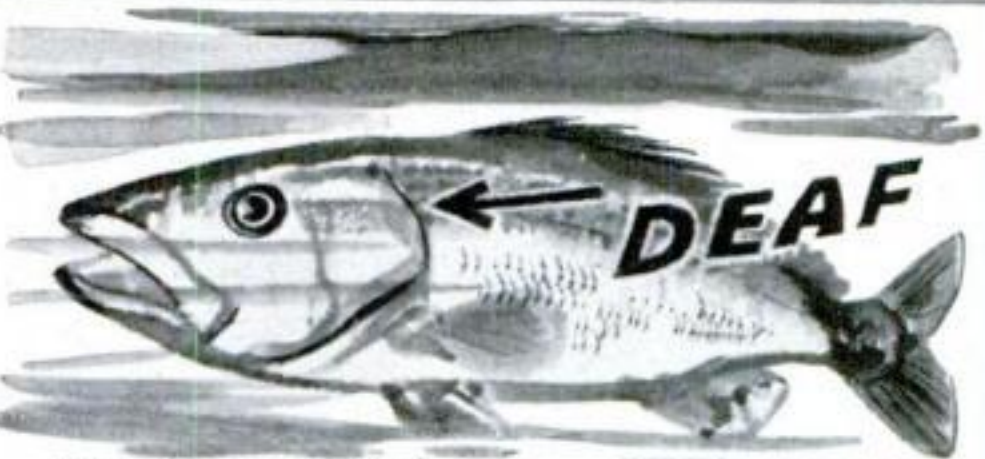
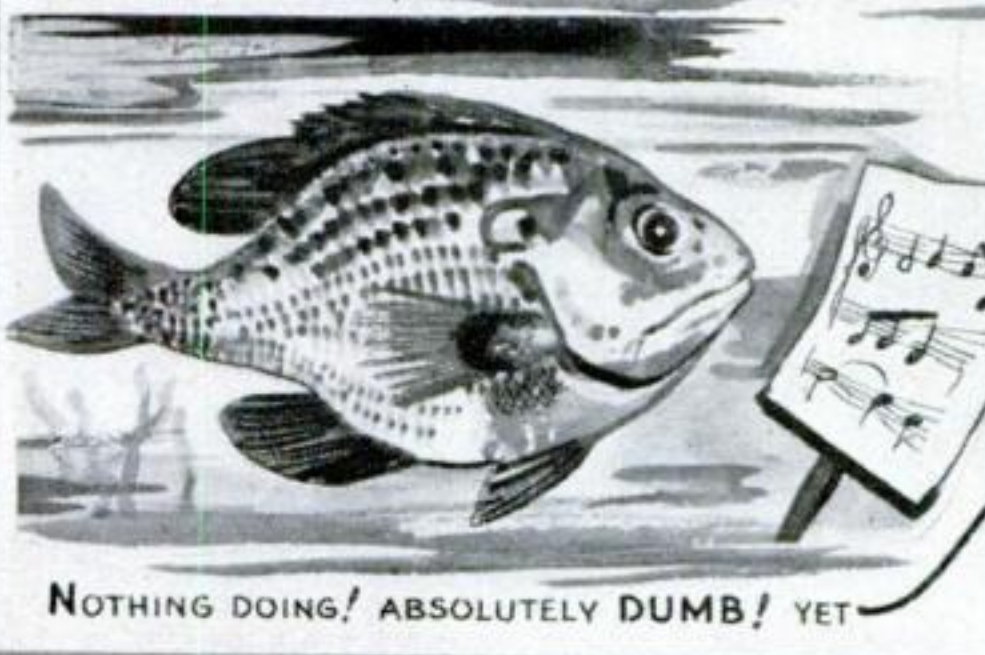
Signpost Scrambles Geography

ARE you as puzzled over the signpost pictured in the photograph above as is the somewhat amazed gentleman shown giving it his undivided attention? The odd highway marker, strange as it appears, is not the result of a map maker's nightmare. It is an honest piece of work, erected for the benefit of travelers along a motor road, giv-

ing accurate information concerning the direction and the mileage to the places named. Where is the sign located? Pick a spot twenty-three miles from Denmark and still only thirty-seven miles from Mexico, and you have your answer. Give up? Well, it's at Lynchville, Me., and the localities listed are all real Maine towns.

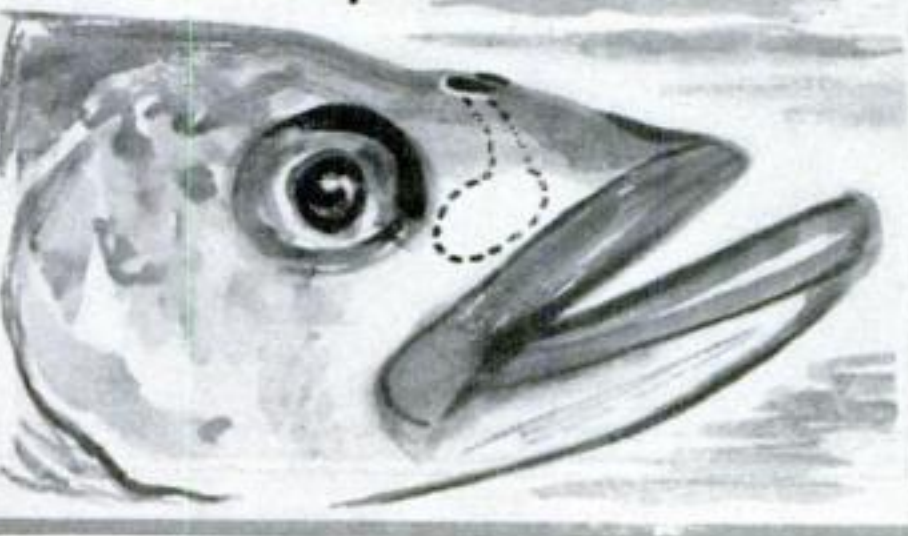
Un-Natural History

By
Gus Mager



NOR ARE THE EARS OF FISH OF ANY PRACTICAL USE, THOUGH FISH ARE EXTREMELY SENSITIVE TO VIBRATIONS!

FISH HAVE NO DELICATE SENSE OF SMELL! THE HOLES THAT CORRESPOND TO NOSTRILS OPEN INTO A BLIND SAC, AND HAVE NO CONNECTION WITH BREATHING OR WITH THE BRAIN!



A FISH'S APPETITE SEEMS TO BE IN NO WAY AFFECTED BY ANYTHING AS TRIVIAL AS A HOOK OR TWO IN HIS MOUTH!



Curtain Vases Hold Flowers

DRAPERIES ornamented with real flowers, instead of floral designs, have been introduced by a New York interior decorator. Pockets in lower folds of the curtains conceal test tubes filled with water, into which cut blooms may be slipped, as illustrated in the photograph above. The result is a gay fringe of blossoms to brighten a room with color.

Greaseless Liquid Waterproofs Cloth

POSITIVE waterproofing is claimed for a new liquid preparation which, according to the maker, contains no grease or oil. Of special interest to outdoorsmen, the compound will make clothing, shoes, and tents impervious to moisture. It may also be used upon automobile tops and tarpaulins. Objects to be waterproofed must be thoroughly clean and dry. The fluid is applied by rubbing with a cloth moistened in it.



Clothing can be waterproofed by rubbing it with a cloth moistened in the new compound

Funnel Treatment Inoculates Trees Against Disease

LIKE human beings, trees can now be inoculated against disease. The new method employs a funnel that is placed around the trunk and filled with a chemical solution. When holes are bored in the tree's bark, the chemical mingles with the sap. The illustration at right shows how the method is used to prevent infection of a tree with the destructive Dutch elm disease, or to kill any fungus already there. A major problem was how to make the funnel water-tight. This was solved by lining the base with a sheath of special material which fills the bark crevices to provide a leakproof seal.



A chemical solution in the funnel mingles with the tree's sap

Newlyweds' Bungalow Costs Only \$2,650

DESIGNED especially for newlyweds, a model bungalow erected with Federal aid at Chester, Pa., is the forerunner of hundreds like it. Costing only \$2,650, the house can be bought with a down payment of \$150 and monthly payments of \$20.90. It has a good-size living room, shown in the photograph reproduced below, two bedrooms, kitchen, bath, and ample closet space.



Model home designed for young married couples. It has an ample living room (left), two bedrooms, kitchen, and bath

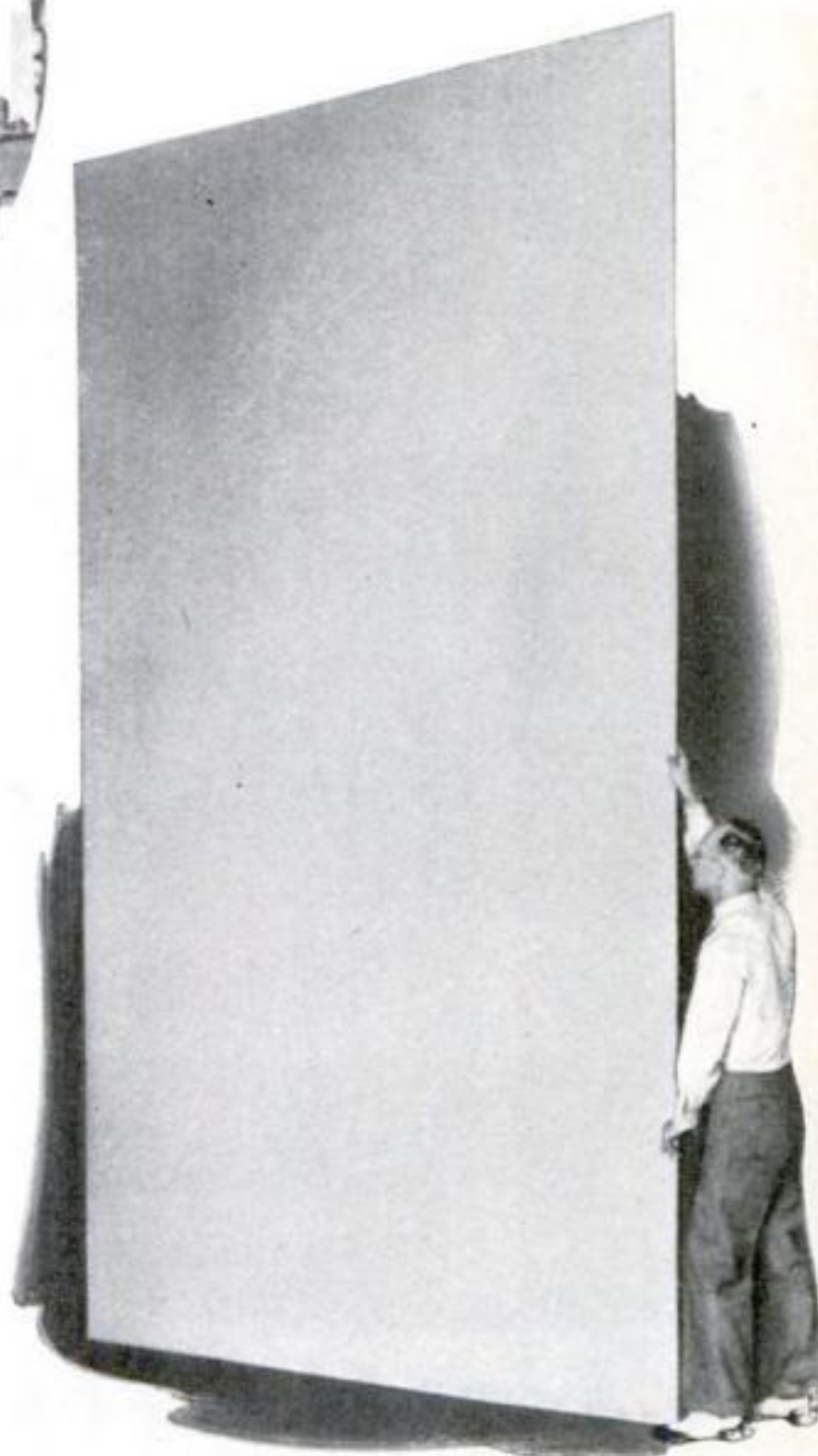


Giant Wall Board Covers Whole Side of a Room

WALL BOARD of giant size, so large that a single panel covers an entire wall without cracks or joints, now is available for time-saving "dry-built" construction. It comes in sheets up to eight by fourteen feet. To the smooth plaster surface, the manufacturer adds a size or primer, so that it can quickly be finished after erection with one or two coats of paint.

Bulb Gives Bright Light

ELECTRIC-LIGHT bulbs that give a brilliant white light are made possible by a new manufacturing process. Tiny wire brushes mounted on the filaments enable the new lamp to operate at higher temperatures than ordinary bulbs without burning out, as vaporization takes place at the brush tips rather than in the filament.

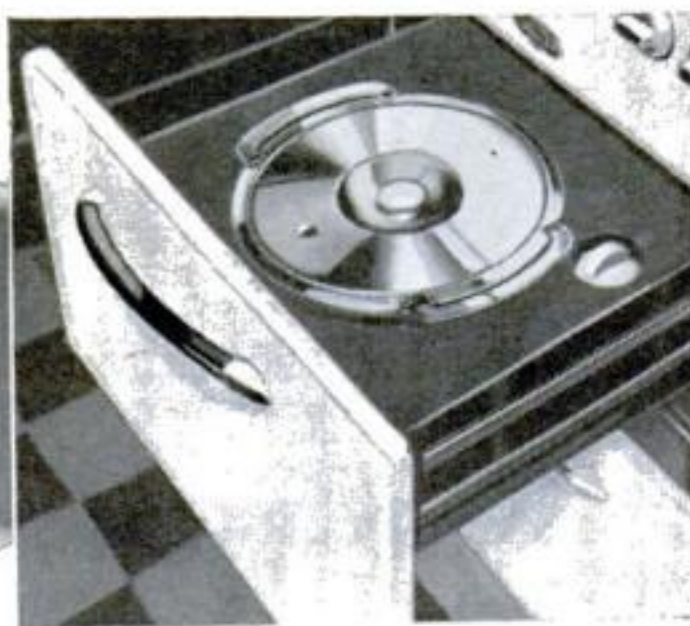
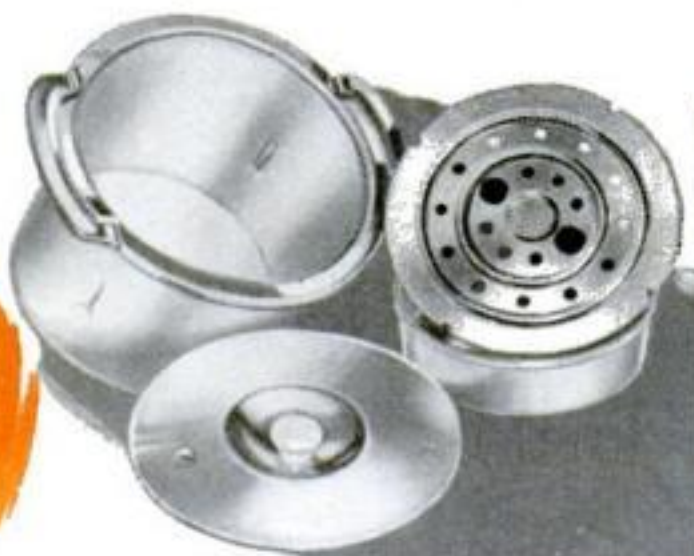




WATER OZONIZER. Tap water that has unpleasant taste or odor is made palatable by an electric device connected to the faucet. When water is turned on, purifying ozone is generated and mixed with it

MENDING TAPE FOR LINEN

Torn sheets, pillowcases, shirts, and other articles can be mended easily with a new tape which is pressed onto the fabric with a hot iron. Since it contains no latex rubber, the tape is not affected by dry-cleaning chemicals



DEEP-WELL COOKER. Among the novel features of a new electric range is a deep-well cooker built into the range top, as shown at upper left. In one model, the six-quart cooker unit is set into one of the large utility drawers of the range, as seen above

TWO CLEANERS IN ONE. Weighing only five pounds, the vacuum cleaner at the left can be held in the hand for dusting and similar jobs. Fitted into a special frame, it works efficiently on floors and carpets

Nine Handy Aids

MOTH KILLER. Every time the closet door is closed, a plunger in the fixture below forces air through a perforated chamber to spray the interior with a chemical that destroys moths



METAL IRONING BOARD

Lifetime service is claimed for the all-metal ironing board illustrated below. Vents in the top carry off the excess steam



TRANSPARENT FURNITURE. This bed and chair are made of a crystal-clear plastic that does not chip, split, or stain



TAP THERMOMETER

How hot is your hot water? This faucet thermometer will tell you. An indicator panel changes color to show if it is too cold, too hot, or as you want it

PLACE-CARD OUTFIT

Attractive place cards are prepared with this kit. It contains celluloid strips, special ink for marking, and stands to hold them up



for the Homemaker



Orchard Railroad Aids Peach Grower

LEO HERMAN, of Tallmadge, Ohio, started his 2,500-foot electric railroad system as a hobby, but now it helps him to care for an extensive peach orchard on a six-acre tract surrounding his home. An electric loco-

motive powered from a third rail hauls the rolling stock of four cars—two flat cars for carrying passengers, tools, and equipment, one specially built to haul spray hose, and a tank car for the liquid spray.

New Concentrated Soup Is Easy To Prepare

DELICIOUS soups are now available to housewives in convenient concentrated form. The concentrate is removed from its package, crumpled, and dropped into a quart of boiling water, as shown below. In a few minutes, a tasty and nourishing soup is ready to serve.



Crumbling concentrated soup into boiling water



Attracted by a cozy nest and free food, moths are killed by a chemical in the trap

Moth Trap Lures Pests

INSTEAD of emitting an odor unpleasant to moths, and merely driving them to another spot, a new moth trap lures the cloth-destroying insects to their death. Clipped to a clothes hanger, the cardboard trap provides a convenient nest with food for the moths. A chemical in the trap kills moths, larvae, and eggs.



When looking straight ahead, how well do you see to either side? With a "perimeter," the seated man is having this vital factor to good driving measured



A hearing test. The same volunteer is followed throughout most of the pictures on this and the next page. Here, his response to sounds of varying intensity is checked

Odd Driving Tests

SEEK THE CAUSES OF AUTO ACCIDENTS

WHAT are the real causes of automobile accidents? In an attempt to shed further light on this complex problem, the Center for Safety Education of New York University, in cooperation with the State Motor Vehicle Bureau and

the Greater New York Safety Council, recently inaugurated an elaborate series of special tests for volunteer groups of metropolitan drivers.

Twenty-five automobile operators, each of whom had driven at least 50,000 miles in the metropolitan area during the last five years without a single accident, form the first group tested, while a second group of twenty-five were picked from those who, in the same five-year period, had been in-

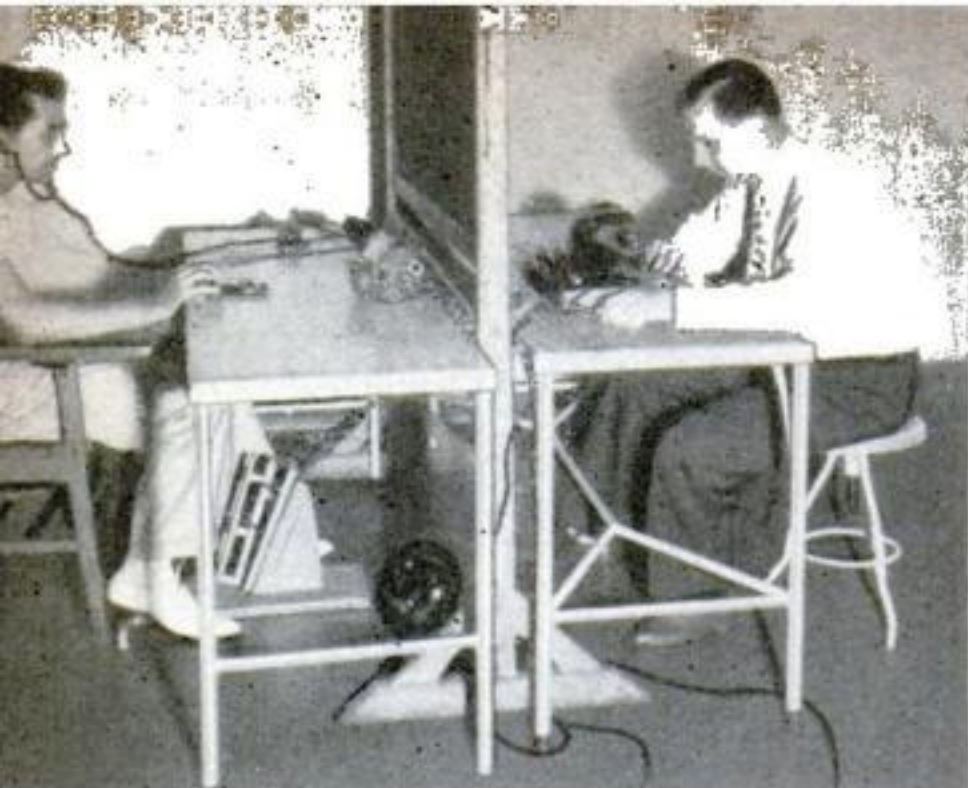


In the dual-control car at left, road tests show up his skill or lack of it

The driver now looks at a bright light inside of an "adaptometer." Temporarily "blinded," he must be able to see normally again within a specified time

Again the driver's eyes are tested, this time for vision under various light intensities, to learn whether or not he is subject to any night blindness





Testing physical reaction. The examiner controls a buzzer and a light. As soon as he operates either, driver, screened from him, must let up telegraph key



Timing of the driver's reaction speed, as tested at the left, is done by the examiner with this apparatus which measures delays to one 300th of a second



involved in at least four accidents, one of which occurred within the last two years. By putting both groups through an extensive series of laboratory and actual driving tests, the researchers, under the direction of Dr. Leon Brody, of New York University, hope to be able to determine what physical and mental factors tend to make good drivers.

To show muscular reactions, driver holds his left foot behind him with his right hand as he hops through intricate system of squares

In specially equipped laboratory rooms, each driver is tested for blood pressure, muscular coördination, speed of reaction to sound and light, vision and muscular control of the eyes, and other physical factors. An impressive array of instruments, including a dynamometer, manoptoscope, adaptometer, and other scientific measuring instruments, is employed.

In a second group of tests, the subjects are sent out on the city streets in dual-control automobiles for actual driving tours. An accompanying observer rates the car operator's driving ability with the aid of a scale chart designed expressly for the purpose. The third part of the complete test series involves written examinations given to check on matters of the subject's personality and general intelligence, as well as on his driving attitude and knowledge of the principles and practices that contribute toward making a person a good driver.

Testing a driver on the road. Given a driving command, he waits to obey it until the examiner flashes a dash light. His reaction time is again recorded

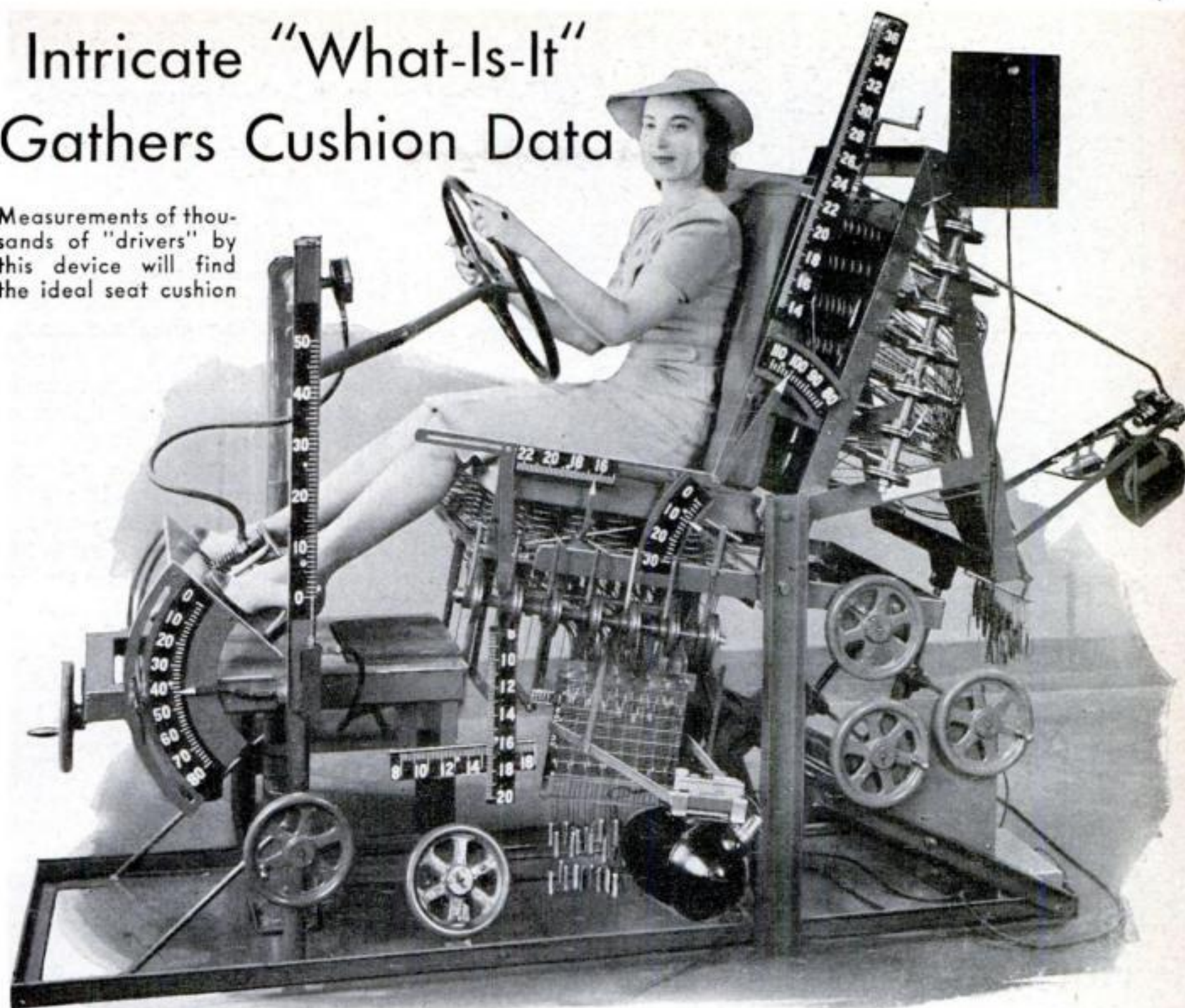


Brief fluctuations in blood pressure arising from various driving experiences are measured as below with a delicate device called a sphygmomanometer



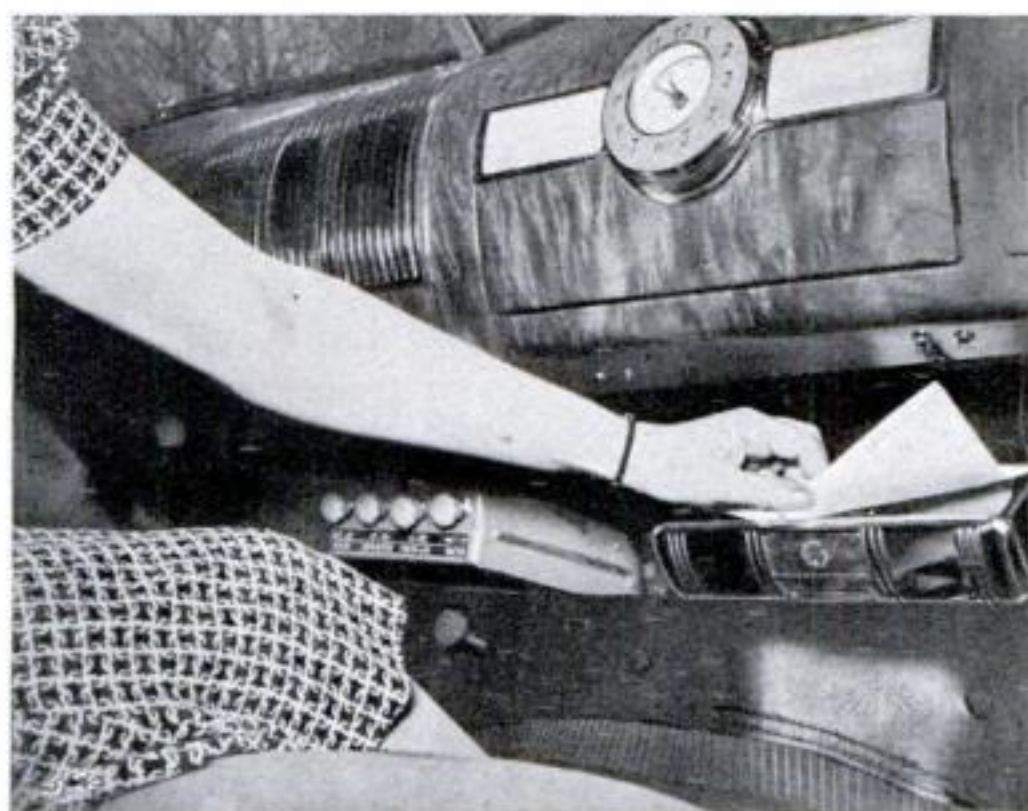
Intricate "What-Is-It" Gathers Cushion Data

Measurements of thousands of "drivers" by this device will find the ideal seat cushion



NO, it's not a car of the future; nor the past either. The strange-looking contraption in which the young woman seems to be going for a drive is designed to gather information for engineers. Installed at the University of Michigan, at Ann Arbor,

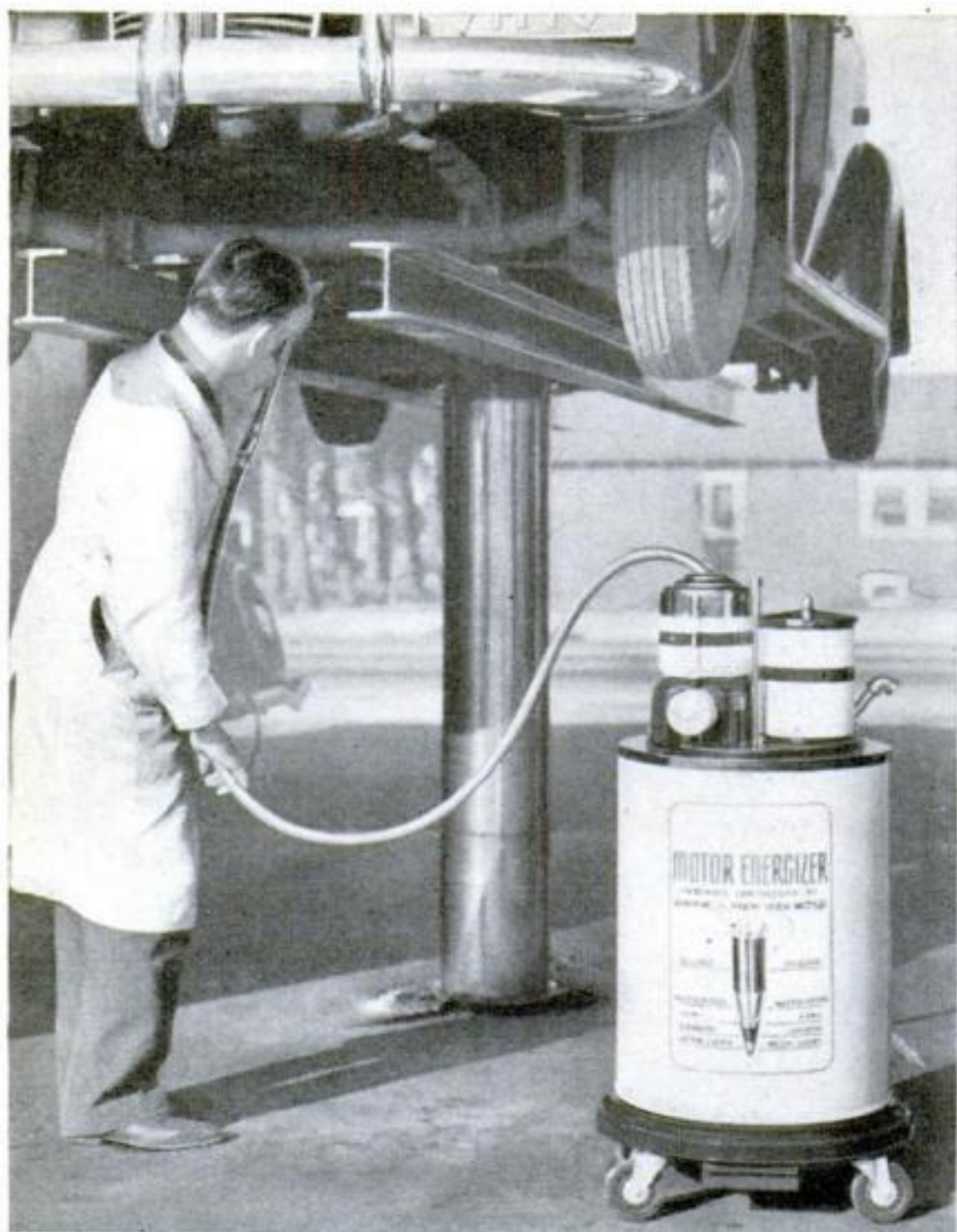
where thousands of persons have sat in it, the apparatus was built for a cushion manufacturer who hopes from countless measurements made on it to obtain an average-size automobile-seat cushion that will be comfortable for the majority of motorists.



How the cleansing-tissue dispenser fastens under the dash

Dash Dispenser for Cleansing Tissue

FACE-CLEANSING tissues, ideally suited for innumerable driving uses; are stored in a convenient dispenser which fits under the glove compartment of the dashboard of one new-model car. Finished to match the instrument panel, the dispenser is offered as an inexpensive optional accessory to buyers. The tissues are handy for dusting and polishing windows, steering wheels, and instruments. They also are a convenience as emergency handkerchiefs for sufferers from colds and hay fever, and other motoring needs.

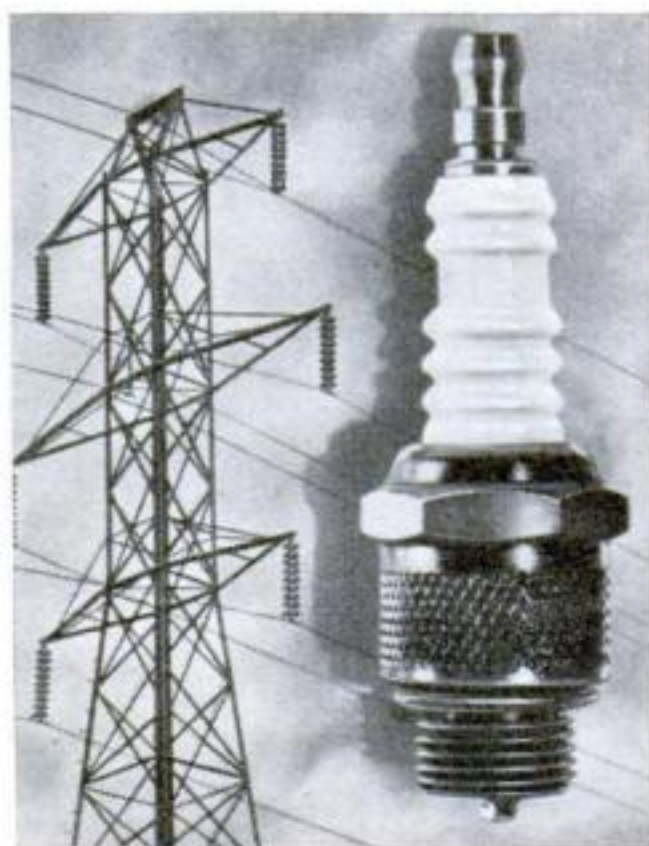


Hot-Oil Flusher Cleans Gears

MOUNTED on casters, an oil-heating and pumping machine for garage use flushes automobile transmissions, rear ends, and crankcases with a flow of thin oil heated to 220 degrees F., to remove all traces of dirt, sticky sludge, and metallic fragments. Oil pumped by the device is sucked back again to boost the cleaning process.

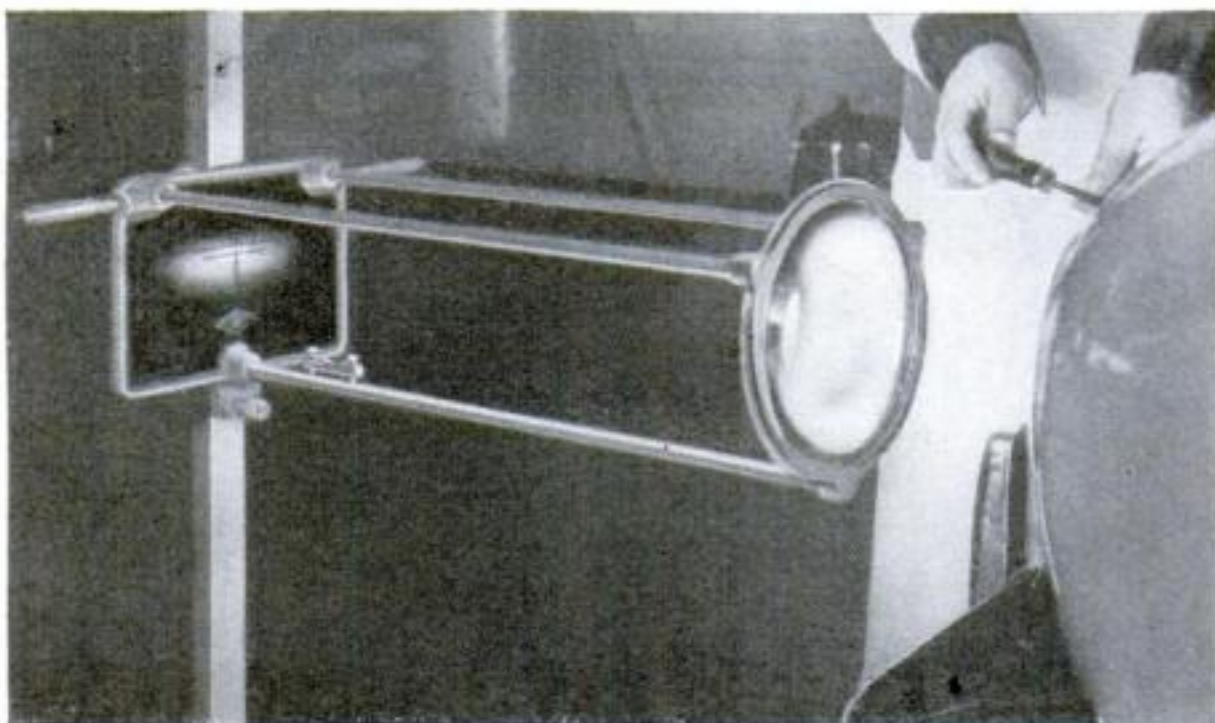
Spark Plug with Skirts Prevents Short Circuits

LONGER trouble-free life is claimed for a new spark plug which represents, according to its makers, the first major advance in plug construction in more than a decade. Taking its cue from the skirted insulators that carry cross-country, high-tension wires, the porcelain insulator sleeve of the plug is ridged by "petticoats" which decrease accumulation of dirt and grease, and increase surface area, lessening the chance of short-circuiting.



Headlight Aimer Saves Time and Space

AN OPTICAL-TYPE headlight aimer using a reducing lens to focus the light beam on a midjet calibrated screen saves both space and working time. Usually, car-light testing jobs require up to twenty-five feet of clear space and a large target. The new instrument requires only four feet in front of a car. Suitable for any type of headlight, the device permits both vertical and horizontal adjustment. It is also available with a light-intensity meter.

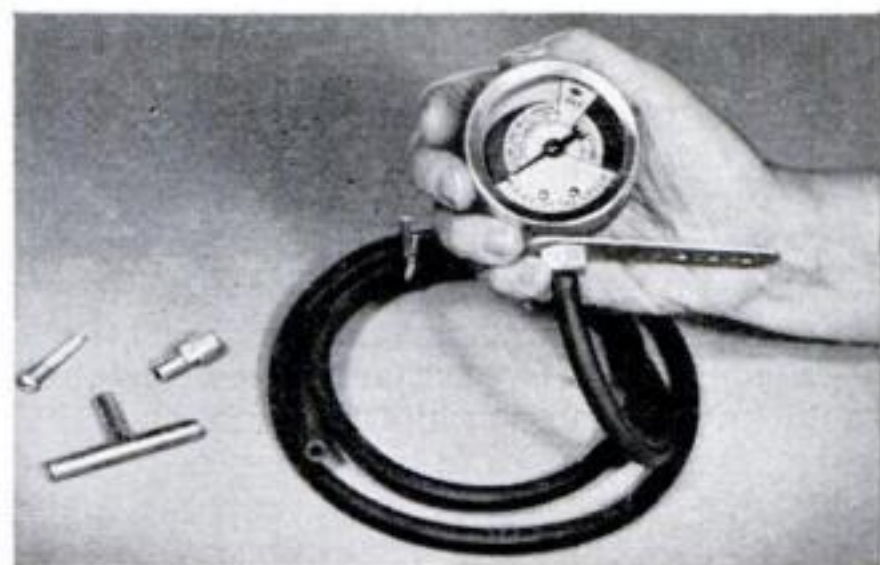
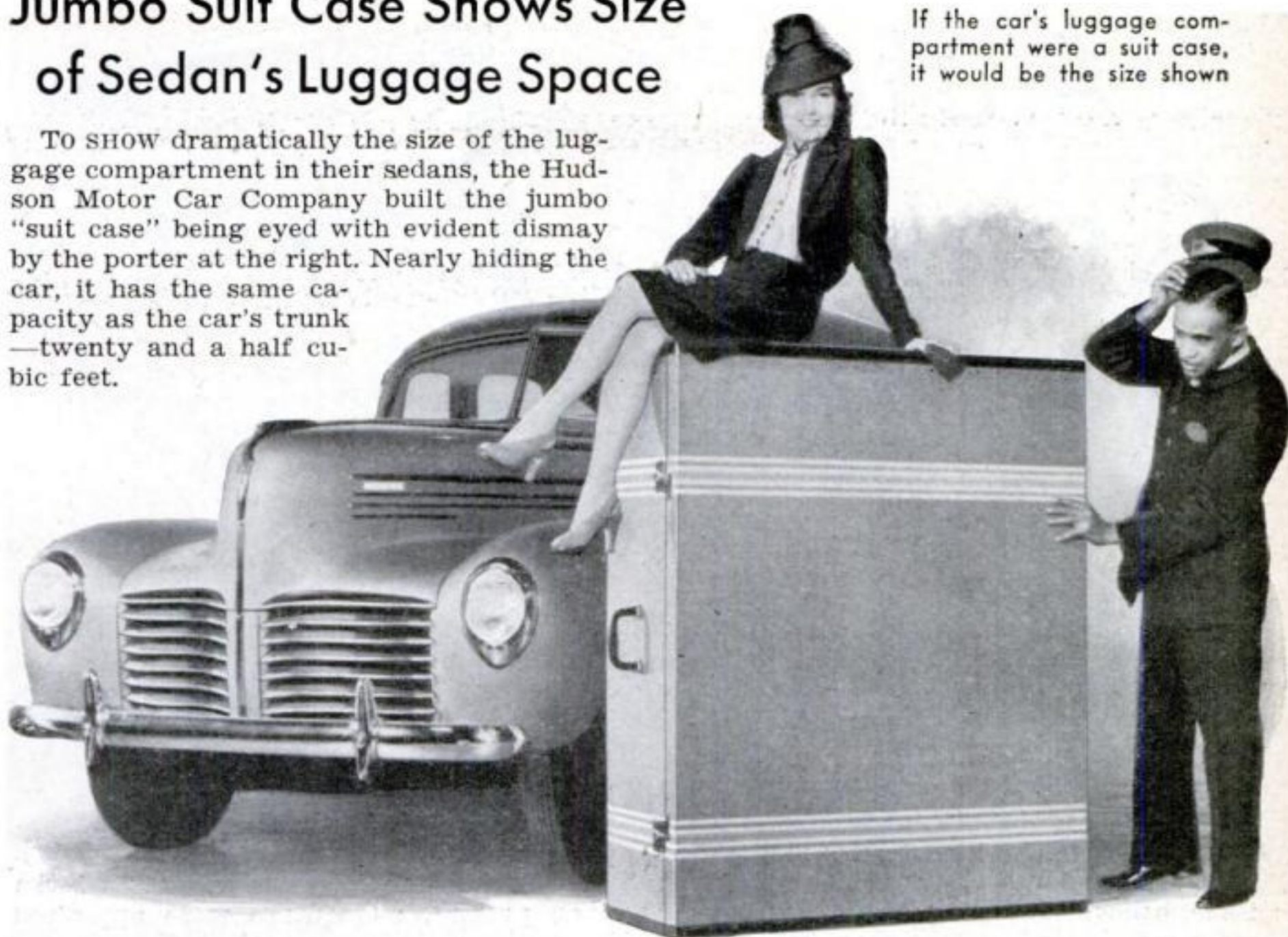


Four feet of space, instead of twenty-five, suffice for this tester

Jumbo Suit Case Shows Size of Sedan's Luggage Space

To SHOW dramatically the size of the luggage compartment in their sedans, the Hudson Motor Car Company built the jumbo "suit case" being eyed with evident dismay by the porter at the right. Nearly hiding the car, it has the same capacity as the car's trunk—twenty and a half cubic feet.

If the car's luggage compartment were a suit case, it would be the size shown



Meter Helps Car Driver Cut Fuel Consumption

How to press the foot accelerator of your car for the greatest gasoline economy under all conditions of driving is indicated instantly by the meter shown above. Easy to install on the dash, or to fasten in place by a windshield-molding screw, the instrument has a pointer which indicates whether gasoline consumption is low, medium, or high. By observing when the consumption is high, a driver can keep from wasting gasoline. The device also indicates the proper fuel consumption for coasting and idling, as a check on motor adjustment.

Handy Brush and Cleaner for White-Wall Tires

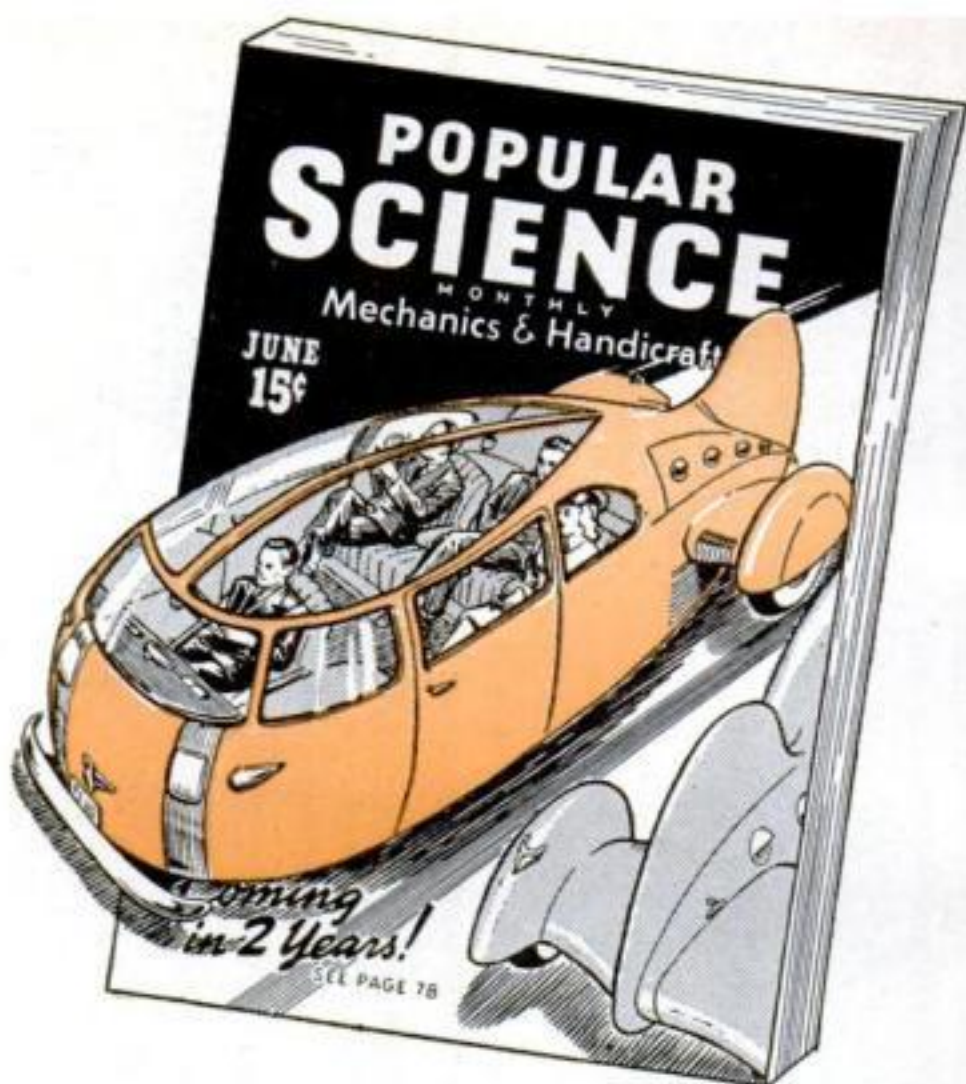
FREE of any bleaching agent or ingredients harmful to rubber, a new preparation just placed on the market for motorists removes dirt, grease, and scuff marks from white-walled tires at the same time that it applies a fresh white coating. The manufacturer claims that the finish will neither crack nor peel off. The compound is packed in thirteen-ounce tins, as shown in the illustration reproduced below, and a special cleaning brush with a convenient handle and fine brass-wire bristles comes with it.



Brush-and-cleaner set to keep white tires spotless

Auto Contest Winners

POPULAR SCIENCE READERS
AIR THEIR "PET IDEAS"
ON THE CAR OF TOMORROW



SIXTY-FOUR PERCENT, or nearly two thirds, of the POPULAR SCIENCE readers who submitted letters in the Car-Design Contest announced in the June issue, believe that the proper place for car motors is behind, rather than in front of, the car's occupants.

Added to this startling majority is the preference of forty percent of the contestants for a car of functionally streamline, "teardrop" design.

In each of the percentages given, the figures represent nearly a unanimous opin-

ion of all who expressed their ideas on those points, with scarcely a handful opposing such drastic changes.

From bumper to bumper, cars of the past, present, and future were appraised by the entrants in the contest, the winners of which, along with those who received honorable mention, are listed on this page. For the most part, the writers agreed that cars should not be larger lest they outgrow private garages, and, as one pointed out, "it's easier to change America's cars than her garages."

A teardrop car incorporating the various ideas suggested by the many contestants would have an underside as smooth as the rest of the body, and windows of transparent plastic would be flush with the body panels to cut down wind noise and resistance. The bodies, of one-piece, metal-reinforced plastic, would be so strong as to dispense altogether with the present-day chassis, while the engine, transmission, fluid-type clutch, drive shaft, rear axles, and wheels, all built as one easily removed unit, would be light and economical to maintain.

Many letters approved fluorescent lighting both inside and out, with all exterior lights recessed in the body and fenders. Sliding doors controlled by push buttons would replace the hinged doors of today. The driver's seat, holding two or more people, would be close to the wide, unobstructed windshield, and ahead of the front wheels. Extending fully around the car would be a rubber and steel bumper of standard height.

FIRST PRIZE, \$50

Wyatt Brummitt, Pittsford, N. Y.

SECOND PRIZE, \$25

Herman Schepler, Dubuque, Iowa.

THIRD PRIZE, \$15

W. H. Kindel, Pueblo, Colo.

FOURTH PRIZE, \$10

Floyd Milton, Worthington, Minn.

HONORABLE MENTION

Clifford Blanke, Los Angeles, Calif.; Don W. Byers, Minneapolis, Minn.; Andrew P. Fischer, Delano, Calif.; P. McCormick Henry, East Falls Church, Va.; J. Metelnick, Winnepeg, Man., Canada; Willard C. Rand, Kansas City, Mo.; Robert R. Sloane, Rochester, N. Y.; Ralph G. Young, M.D., Long Beach, Calif.



Mechanic's Stethoscope Diagnoses Auto Ills

RESEMBLING a doctor's stethoscope, a handy new tool enables the automobile mechanic to diagnose car ills. Consisting of a length of rod and rubber tubes leading to earpieces, the device is pressed against a spot on a motor, clutch, transmission, or rear end, near where the trouble is thought to be. It quickly locates knocks and squeaks.

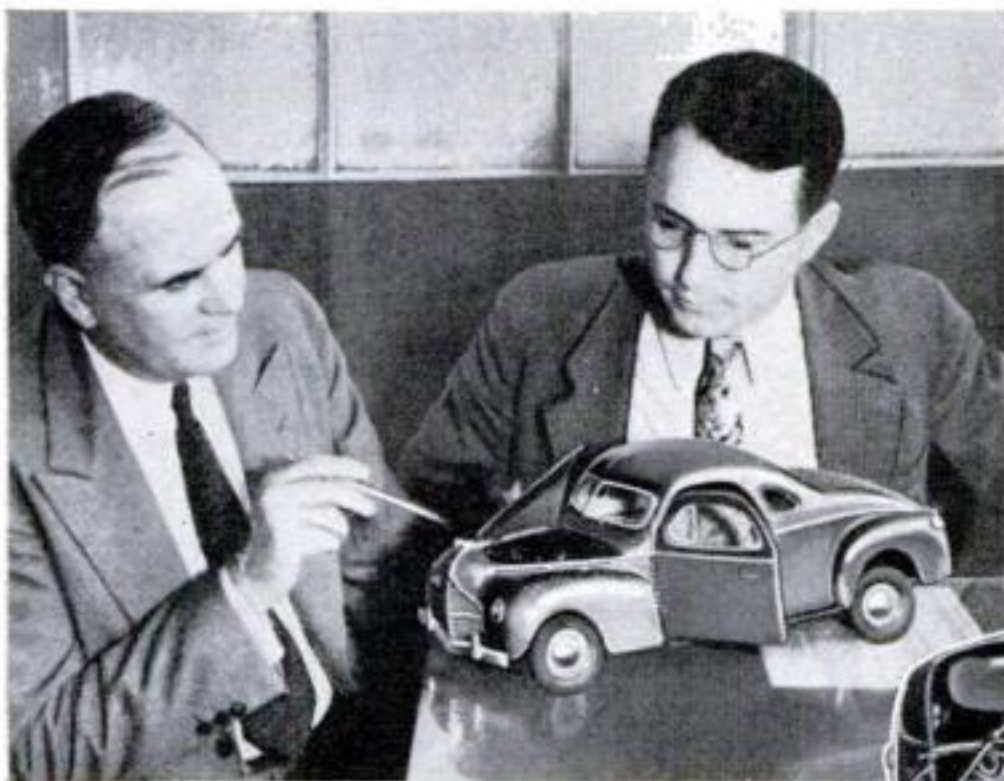
Cleaner Takes Bug Stains from Automobile Finish

LATE-SUMMER drivers will welcome the cleaning compound shown in use in the picture below, for cleaning dried bugs and bug stains from the fenders, radiator grilles, windshields, windshield frames, and other parts of the car. It contains a chemical compound that reacts quickly on bugs without harming the car finish. To use the cleaner, the surface to be cleaned is first wet with water. The powder is then sprinkled from its shaker-top can on the stained area, rubbed with a damp cloth, and rinsed off.



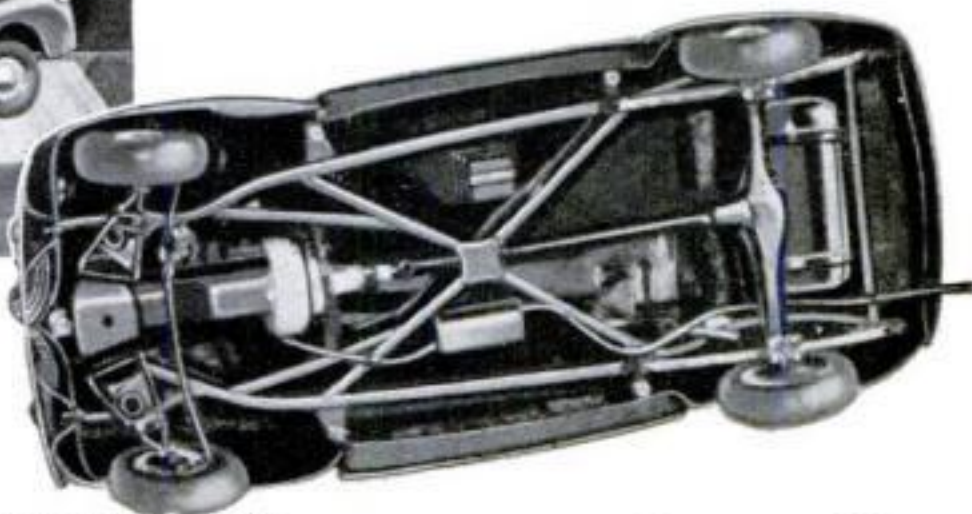
The bug remover is simply rubbed on with a cloth

Owner Builds Working Model of His Car



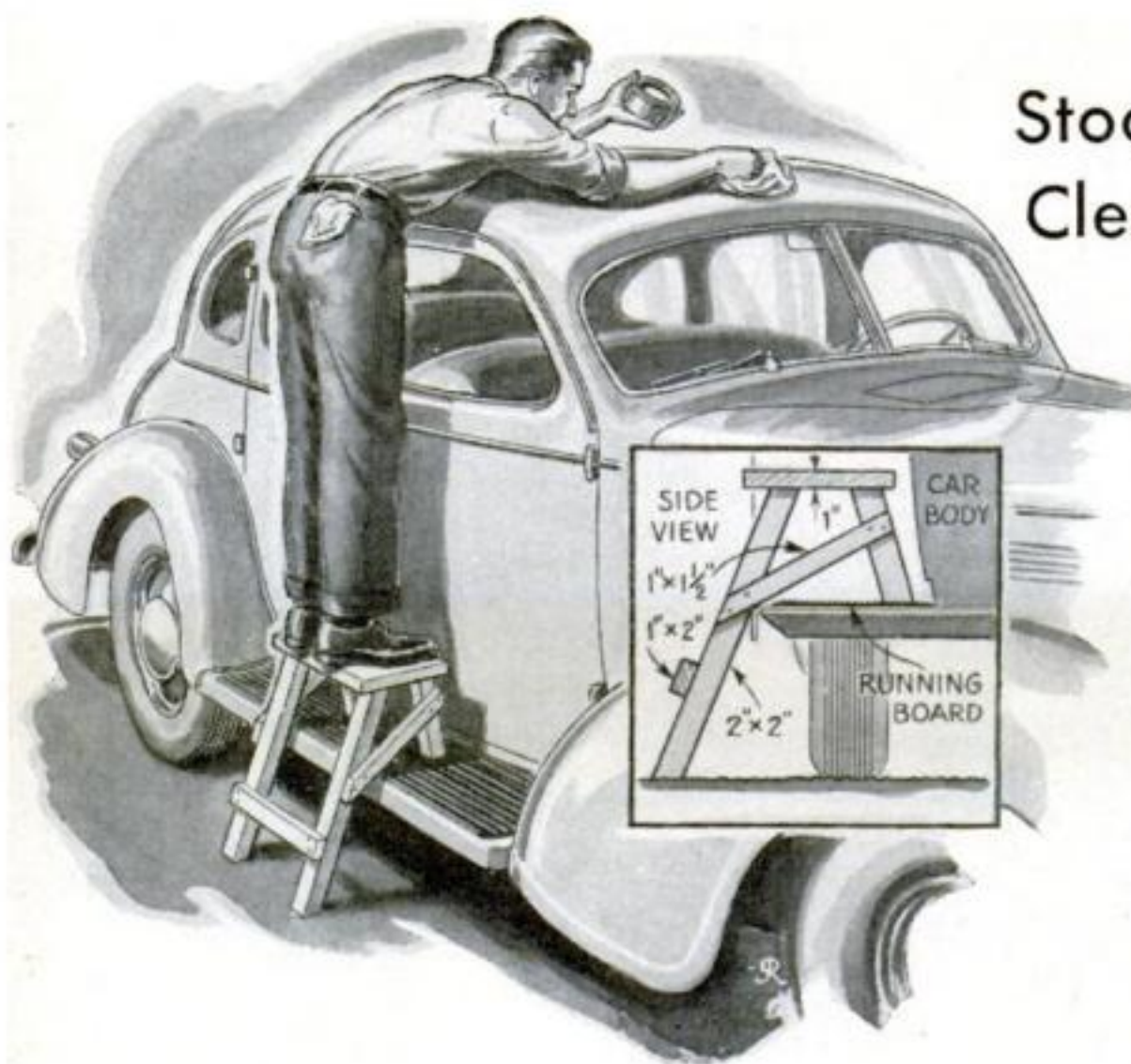
Two appreciative experts—G. B. Allen, chief engineer, and A. H. Fries, assistant chief engineer of the Dodge Division, Chrysler Corporation—inspecting the scale-model coupe

REPRODUCING practically all operating parts with such precision that they function perfectly, the model of a popular stock-model coupe shown in the accompanying photographs was copied from his own car recently by Philip Johnson, of Vermillion, S. Dak. Individual front springs, clutch, brakes, gearshift, engine fan, ventilators, windows, hood, and doors, all operate realistically.



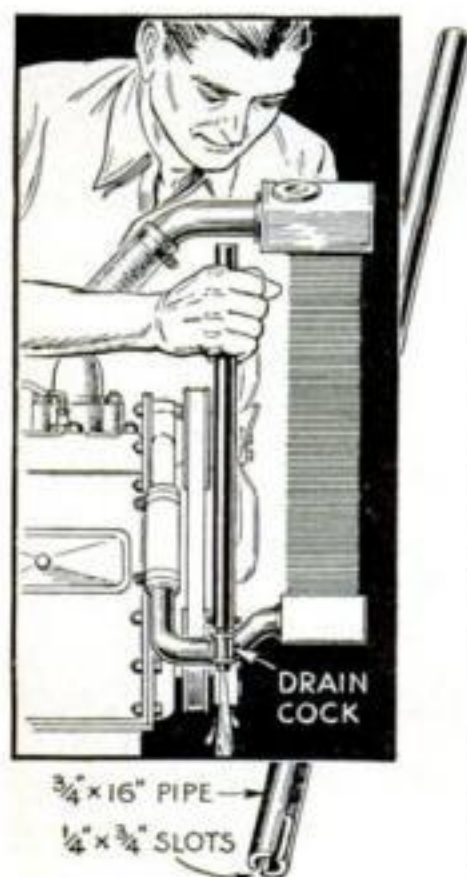
REPAIR STUNTS

Stool Gives a Lift for Cleaning Top of Auto



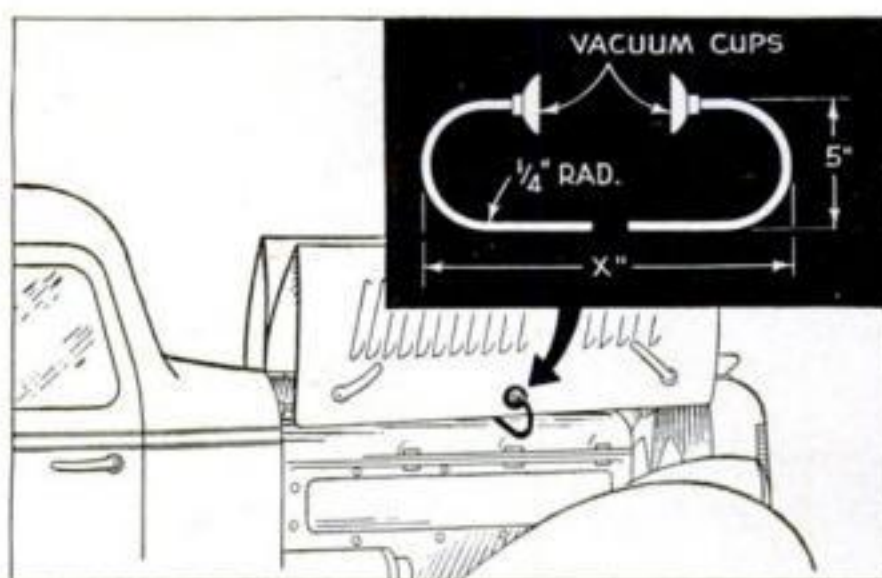
IF YOU ever tried to balance on the running board of your car while washing or polishing the top, you'll appreciate the usefulness of the stool shown in the accompanying sketch. It can be made easily from a few pieces of wood, the dimensions of which are suggested in the drawing. The length of the legs of the stool should be determined by the height of your running board and your own height. Be sure to make it high enough to allow you to reach a little more than half way across the car top from either side without stretching.

—F. G.



Slotted Pipe Easily Opens Radiator Drain

RADIATOR draining is made easy with a section of $\frac{3}{4}$ " pipe 16" long and slotted at one end, as shown at the left. The pipe is easy to lower over the usually inaccessible petcock to open or shut it. It will save scratched hands and spotted sleeves—to say nothing of tempers.—V.C.



Bracket Holds Both Sides of Car Hood at Once

IT IS often necessary to hold up both sides of an old-style car hood while doing minor repair jobs, but they will not always stay put. A useful holder can be made from a $\frac{1}{4}$ " pipe or rod and two good-quality vacuum cups. Bend the rod as shown. Attach a vacuum cup to each end of the rod. The distance between them depends upon the car, but usually about 18" is sufficient. To attach, fasten the vacuum cups on the lower edges of the hood covers, with the rod under the covers, as shown in the illustration above.—E. B.

Tire Dust Caps from Erasers

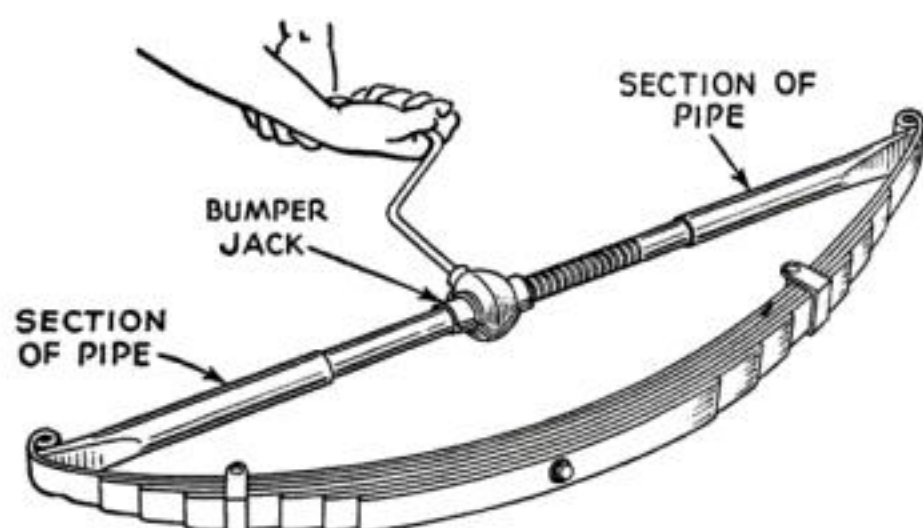
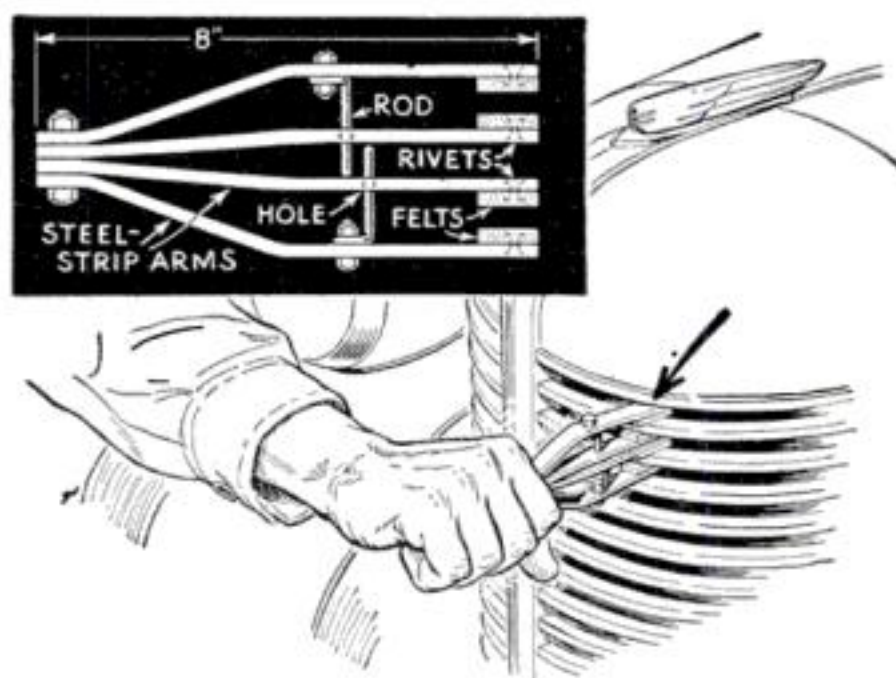
RUBBER erasers of the type made to slip over the end of a pencil make handy dust caps for tire valve stems, and save time when you stop for air.—W. J. I.



For CAR OWNERS

Tool Cleans Car's Grille Two Strips at a Time

THE little time it takes to make the device illustrated at the right will be well repaid by the speed with which it polishes close-spaced radiator grille strips. Soft countersunk rivets will hold the felt pads permanently in place, but good rubber cement may be substituted. Spacing of the jaws is determined by your grille strips. Squeezing the device causes each pair of pads to close on a separate strip.—F. G.



Jack Spreads Springs

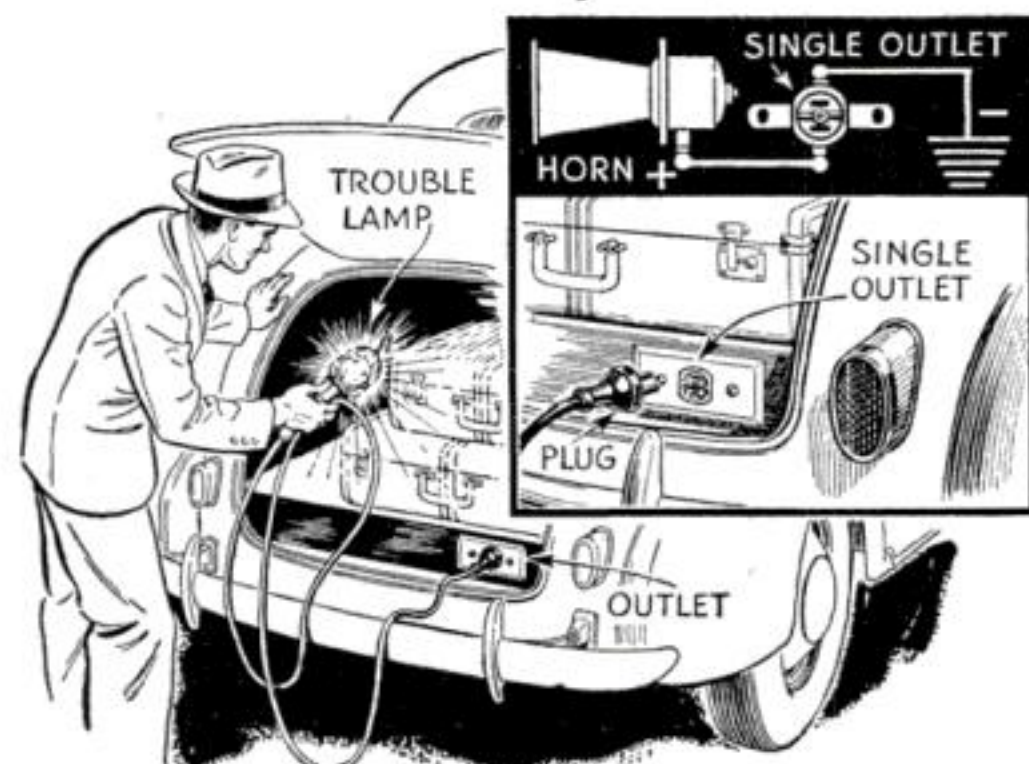
SPREADING a car spring so that the shackle bolts will slip into place can be done easily with a bumper jack and two pieces of pipe. Hammer one end of each pipe flat and place the pieces over the ends of the jack, as shown. The outfit easily spreads a spring to the desired point.—J. H.

Easily Made Die Clears Damaged Axle Thread

WHEN removing rear wheels, the axle threads sometimes become damaged. An easily made die to clear them may be made by cutting in half a spare nut of the same thread, as shown at the right, and clamping the halves over the undamaged thread with a monkey wrench. The halves are then screwed off over the damaged thread, thereby clearing them.—S. A. T.



Trouble-Lamp Outlet for Luggage Trunk



OF REAL service during nighttime repairs, particularly on the road, is a trouble-light outlet such as the one shown mounted in some convenient spot in the luggage compartment. Connected by rubber-insulated wire to the hot terminal of the horn or ammeter, and to ground, the outlet is a conventional wall-type unit such as is used in homes. In place of a house-current bulb in the trouble lamp, one of six volts is substituted. The lamp cord should be long enough to reach any point on the car, so that you will not be "caught short" in any emergency.—A. M.

Gus Beats the Heat

THE afternoon was sunny and hot, and for once there weren't any jobs standing in the shop waiting to be worked on. So Gus Wilson, sitting in the shade of the little porch outside the office, was taking it easy and watching the cars go by.

The suburban-town Model Garage, which Gus and his partner Joe Clark have built into a satisfactorily properous business, stands on a main road at the foot of a slope. Gus had just filled and lighted his second after-lunch pipe when he heard an engine sputter and quit, and saw a well-shined-up sedan stop at the beginning of the upgrade.

A fat man wriggled out from under the steering wheel, and an equally fat and very flustered-looking woman moved over into the driver's seat. The man walked wearily around to the rear end of the car, took the cap off the gas tank, climbed up on the bumper, shouted something to the woman, and then blew gustily into the tank. The car began to move again, slowly and with a succession of back fires which

sounded like a burst from a machine gun. The man on the bumper continued to blow into the tank.

Suddenly the woman who was driving made a 'U' turn. As soon as its nose was pointed downhill, the sedan's engine took hold and ran smoothly. The car turned in at the driveway and stopped at the gas pump. The man got heavily down from his perch on the bumper and demanded to know what was the big idea.

"I've had enough of this!" the stout woman told him dangerously. "I'm tellin' you, George—*get it fixed!*"

The man puffed out his cheeks—they were purple from his blowing—and glared at her. "I suppose you think *I* like it!" he said bitterly. Then he turned to Gus. "Name's George Hawkins—this is Mrs. Hawkins. Live up in Rhode Island. We've had this car for four years, and until day before yesterday we never had any trouble to amount to anything with it. Then it went bad on Mrs. Hawkins—ran all right on the

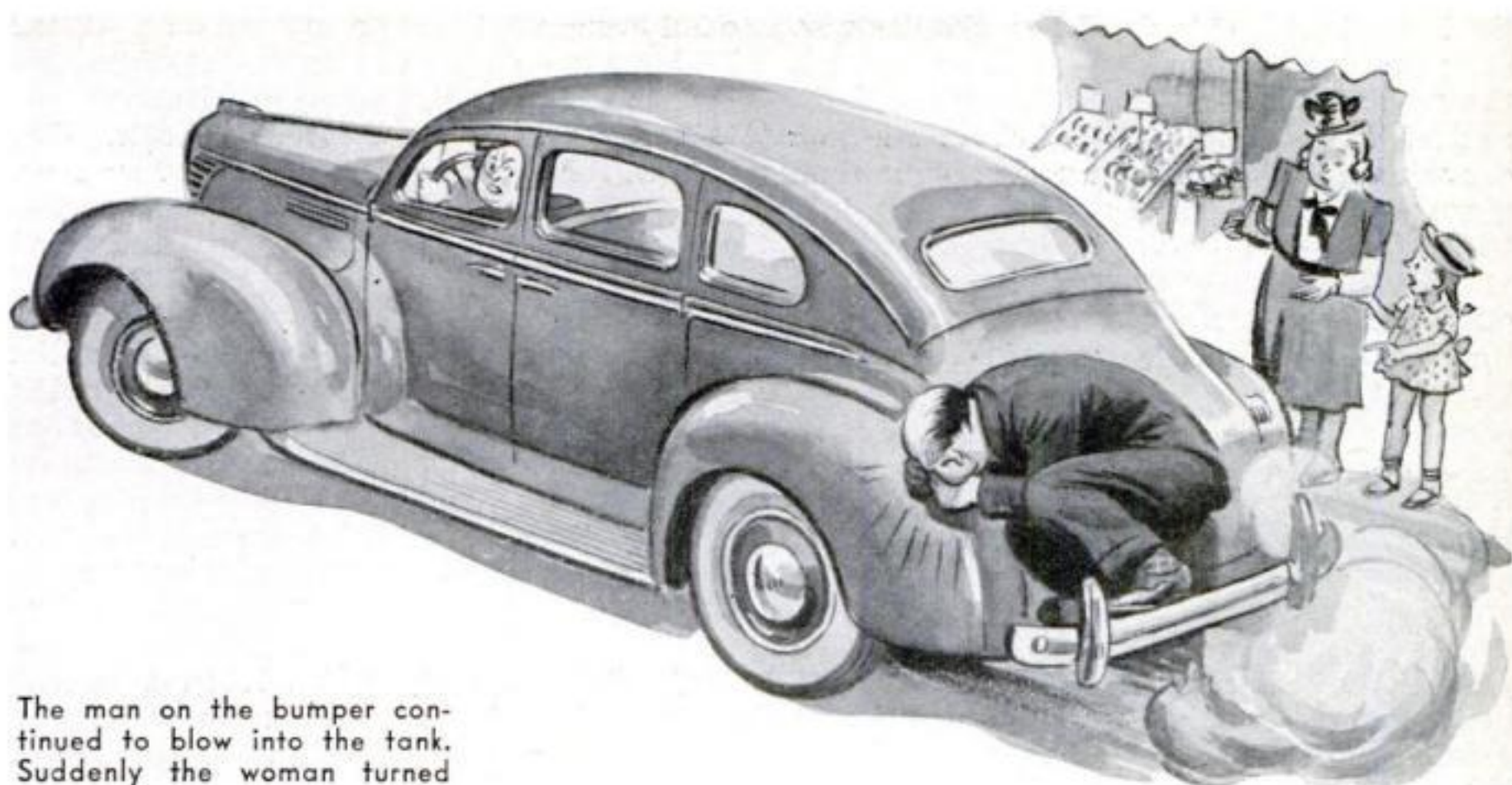
level, but acted like the gas line was clogged every time she tried to go up a hill. We were starting on our vacation trip yesterday morning, so that night I took the bus to a garage and had it gone over. They checked the carburetor and fuel pump, and blew out the gas line, and told me I wouldn't have anything to worry about. Ain't that right, Estelle?"

Estelle snorted. Gus couldn't make out whether she was registering agreement or disgust. Her husband swallowed nervously and went on with his tale of woe:

"We started out yesterday morning, and for fifty miles or so things went all right. The car didn't have as much pep as usual, but we didn't



Harry shifted the lever into reverse and again let out the clutch. "Diagnosis: Short circuit," Gus said. "Where? And why?" Dr. Foley demanded



The man on the bumper continued to blow into the tank. Suddenly the woman turned

have any real trouble. Then we got into the Connecticut hills, and—oh, boy! Every time we tried to go up a grade, the car acted like it had a bad case of vapor lock. If the hill was at all steep, the motor would quit dead. After a while I got the idea that if I blew into the gas tank it would force a little gas into the carburetor. That worked well enough to keep the bus going, but before long I was darned sorry I'd ever thought of it! Every time we hit a hill, I'd have to climb out on the back bumper and blow my lungs out!

"We called it a day early in the afternoon, and I took the car to a small-town garage. Sure, the feller there said, it was vapor lock, and he knew how to fix it. He put in a new gas line from the fuel pump to the carburetor, keeping it well away from the manifold. He charged me plenty for the job, but he told me I wouldn't have any more trouble. He's a liar! It's been just as bad all day today, and I'm sick and tired of sitting out there on the bumper blowing my heart out and listening to a lot of smart guys make wisecracks!"

"And I'm sick and tired of this whole fool trip, and of everything about it," his wife put in grimly. "Fix this car up so we can get home, Mister, and I swear I'll never set foot in it again!"

"I don't blame either of you for being disgusted," Gus told them, managing to keep his face straight. "There's nothing that'll spoil a vacation trip

quicker than a balky car. But if you'll drive into the shop I think I can fix up your trouble for you."

As Mrs. Hawkins drove into the shop, her husband followed Gus. "Make it good, Mister," he begged. "Estelle's plenty sore, and if you fall down she'll sure give me hell!"

"You'll be a lot more comfortable waiting in the office, Mrs. Hawkins," Gus told the peevish lady, as he held the door open for her. When she had vanished in sultry silence he got into the car and stepped on the starter. The engine took off, but its sound told Gus that it wasn't getting enough gas.

Leaving it running at moderate speed, Gus got out, raised the hood, and examined the fuel pump and carburetor. "The fuel pump is pumping scarcely any gas," he remarked. "The main gas line has been checked twice, so it's pretty certain to be O.K." He leaned over and eyed the rubber hose connecting the gas line and the pump; then took it off. "This might be the joker," he said. Attaching an air line to the hose, and holding a swarthy thumb over the other end he lowered it into a pan of water. Dozens of little bubbles formed on the hose and came to the surface. "That's your trouble maker," he decided.

He examined the hose closely, then handed it to Hawkins. "There are several small holes in it," he told him. "See what's been happening? Gas hasn't been leaking out of

**Use Your Head
Instead of Your
Hands And You'll
Keep Cool In Any
Kind of Weather**

By MARTIN BUNN

the hose. If it had been, the mechanics who have worked on your job would have located the trouble. Instead of that, air has been sucked in through those holes. As you drove uphill, the suction was stronger than it was on the level, and so much air got into the mixture that it killed your engine. When you blew into the tank—that's a new one on me—it forced more gas into the fuel line, and that kept your engine running. Easy to fix; just a length of new hose."

Five minutes later Hawkins went into the office, and then came out with his wife. She listened grimly to Gus's explanation of the cause of the trouble, and as grimly to the smooth hum of the engine. Then she got heavily into the car.

"I hope you have a pleasant trip home, Mrs. Hawkins," Gus ventured with a grin.

For the first time she smiled. "I guess as long as we've had all this trouble coming down here," she said, "we might as well visit my sister in the city." She looked at her husband, and her face grew grim again. "Get in, George!" she snapped. "Don't stand there wasting the rest of the day!"

Gus watched them drive away, thanking his stars—not for the first time—that he had remained a bachelor. Then, just as he was heading for the cool office porch, Dr. Foley drove up to the shop door. "Hello, Gus," he greeted. "Busy?"

"No, Doc," Gus said. "Just dog lazy."

"It's the weather," the doctor said. "Maybe that's what's the matter with my car, too. I can't think of anything else. It runs fine going ahead, but the motor dies every time I put it in reverse. Diagnose that case, will you, Gus?"

"Not until I've examined the patient, Doc," Gus said, grinning. "It wouldn't be professional—it would make it seem too easy. You know that. Drive her in, please."

Dr. Foley drove into the shop. "Jack up the rear end, will you?" Gus asked Harry, the grease monkey. "Probably something has gone wrong with its appendix, or maybe its tonsils," he told the doctor.

But a routine check beneath the car failed to disclose anything wrong.

"Huh!" Gus grunted. "Well, I'll give her a road test."

He was back inside a quarter hour. "Just as you said, Doc," he remarked as he got out. "Runs swell going forward, and goes

dead every time you go into reverse. Guess I'll have to do a job of trouble-shooting. Get the rear end jacked up again, Harry."

Harry jacked up the rear wheels. Gus raised the hood and relighted his pipe. "Get in," he told Harry, "and step on the starter." The engine started promptly and ran sweetly. "Now put her in reverse," he directed.

Harry did as he was told and let out the

clutch. Gus's quick eye saw a spark at the rear of the engine just before it stopped. He peered in, then put his hand in and moved something. "Start her again," he said. "Now put her in reverse."

Harry shifted the lever into the reverse position, and again let out the clutch. The engine continued to run smoothly.

"Diagnosis: Short circuit," Gus said.

"Short circuit?"

Where? And why?" Dr. Foley demanded.

"Here's the low-down on your trouble," Gus explained. "Your engine is mounted on rubber, and it moves on its mountings. When the car is moving forward, the engine settles down on the mountings. But when you go into reverse, the forward end of the engine seems to be raised a little by the torque, and its rear end settles back a little. Now, the primary wire to the distributor passes through a narrow space between the dash and the oil-filler pipe. When I saw a spark there when Harry reversed, I knew what had happened—that the movement of the engine on its mountings had chafed through the insulation of the distributor wire, just behind the filler pipe. When the car was moving forward, and the engine settled down on its mountings, nothing happened. But every time you went into reverse, the changing position of the engine squeezed that bare spot on the distributor wire between the filler pipe and the dash. That caused a short circuit which killed your engine. Fix it up, Harry."

Dr. Foley drove away, and Gus went back to the office porch. Joe Clark looked up from a ledger. "Nothing in the shop?"

"Nothing much," Gus told him. "Just a couple of those little things that are hard to find and easy to fix."

"Nothing in them," Joe said gloomily.

Gus laughed. "Sure there is," he said. "Not much profit, but they're swell jobs for a hot day—they keep the old bean working, and don't make you sweat too much!"

GUS SAYS:

Don't let air out of your tires on a long trip because they've gained pressure from heat. They won't gain enough pressure to do any harm. And letting air out will only make them get hotter when you resume your journey, because they'll flex more.

THE HOME WORKSHOP



In This Issue.. GAME-BIRD PLAQUES • PHOTO HINTS
SHOP AND ELECTRICAL SHORT CUTS • RADIO

By
**KENNETH
MURRAY**

Below, the first step is to saw an opening through the wall for the secret door, unless there is already a door in the desired position. If so, the "bookcase" may be added to it without difficulty



So attractive is this bookcase, it would tempt almost anyone to step up and examine the titles, yet it isn't a case and hasn't any books. Instead, it's a secret door leading to another room

This Bookcase



At left, fitting the wide frame, which was made from white pine. Below, the wood strips for around the door and to imitate "shelves" were sanded to even thickness by clamping a wooden guide block to the bed of the sander



SECRET doors, suggesting mystery and intrigue, are interesting to every one. It is not necessary to have a valid reason for building a secret door, although two can readily be found. One is that they can be made more ornamental than a plain door; the other is that they provide a legitimate means of surprising and amusing friends and visitors.

This secret door, which was built into a wall of the writer's office, appears to be a well-stocked bookcase, but when a button is pressed it opens silently into an adjoining workshop and studio. The effect has proved particularly gratifying when the door is opened at the moment a visitor is reading the titles of the books.

An opening about 35" wide and 74" high was made in the wall, and 12" wide pine boards were cut to make a frame. Most of the extra width of the frame was allowed to project from the wall to form the "bookcase."

A piece of $\frac{1}{2}$ " plywood ($\frac{3}{4}$ " would be still better) was cut to fit loosely inside the frame. Wood strips about $\frac{3}{8}$ " square were glued to the face of the plywood door around the edge to form a rim. Other strips of the same thickness but $\frac{3}{4}$ " wide were glued across the door to look like the edges of the shelves.

As it is difficult to obtain enough old books that may be mutilated for this purpose, it is best to purchase imitation book backs

from either a furniture dealer or a book-seller. They are commonly supplied to dealers by bookcase manufacturers in order to dress up their products when on display.

If the backs are in strips, they may be glued directly between the shelving strips on the door; otherwise they should first be glued individually to strips of plywood of the proper width and thickness. A space should be left at the bottom of the door for an imitation drawer front, of plywood.

When the door has been completed and hung with butt hinges, any suitable molding may be nailed around the front edge of the frame to conceal the junction of the door and the frame. The exposed wood parts may be stained and varnished or enameled.

Fit a spring at the back to open the door, and in the frame install an electric door opener, which may be purchased from any well-stocked electrical dealer.

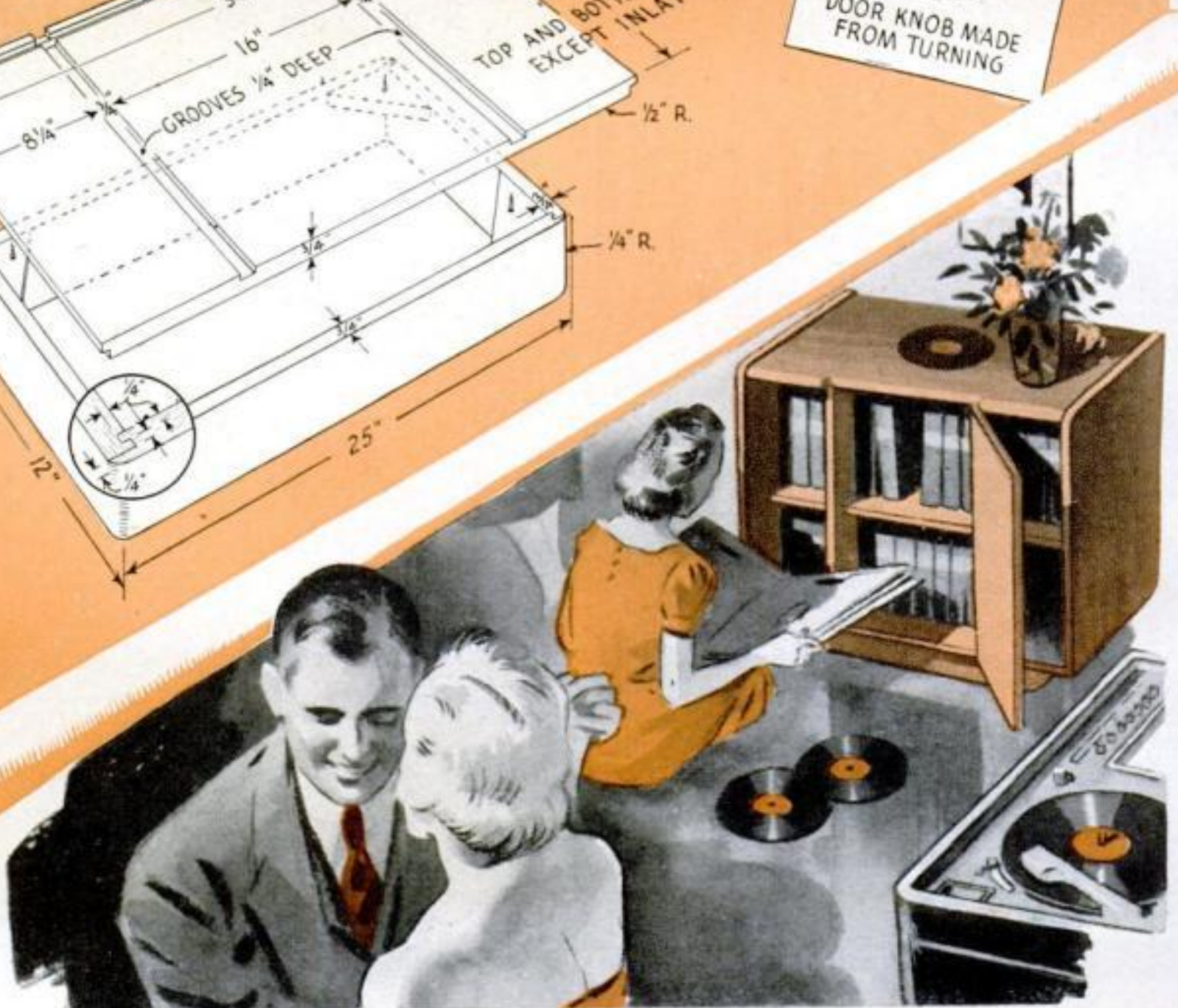


Is a Secret Door



Top view, gluing book backs to plywood strips. The backs are then attached to the door, and an imitation drawer front is added as shown at the left. Note how the door is hinged to the frame

INLAY DECORATION
WALNUT BURL 10" DIA.
LACEWOOD
3" DIA.

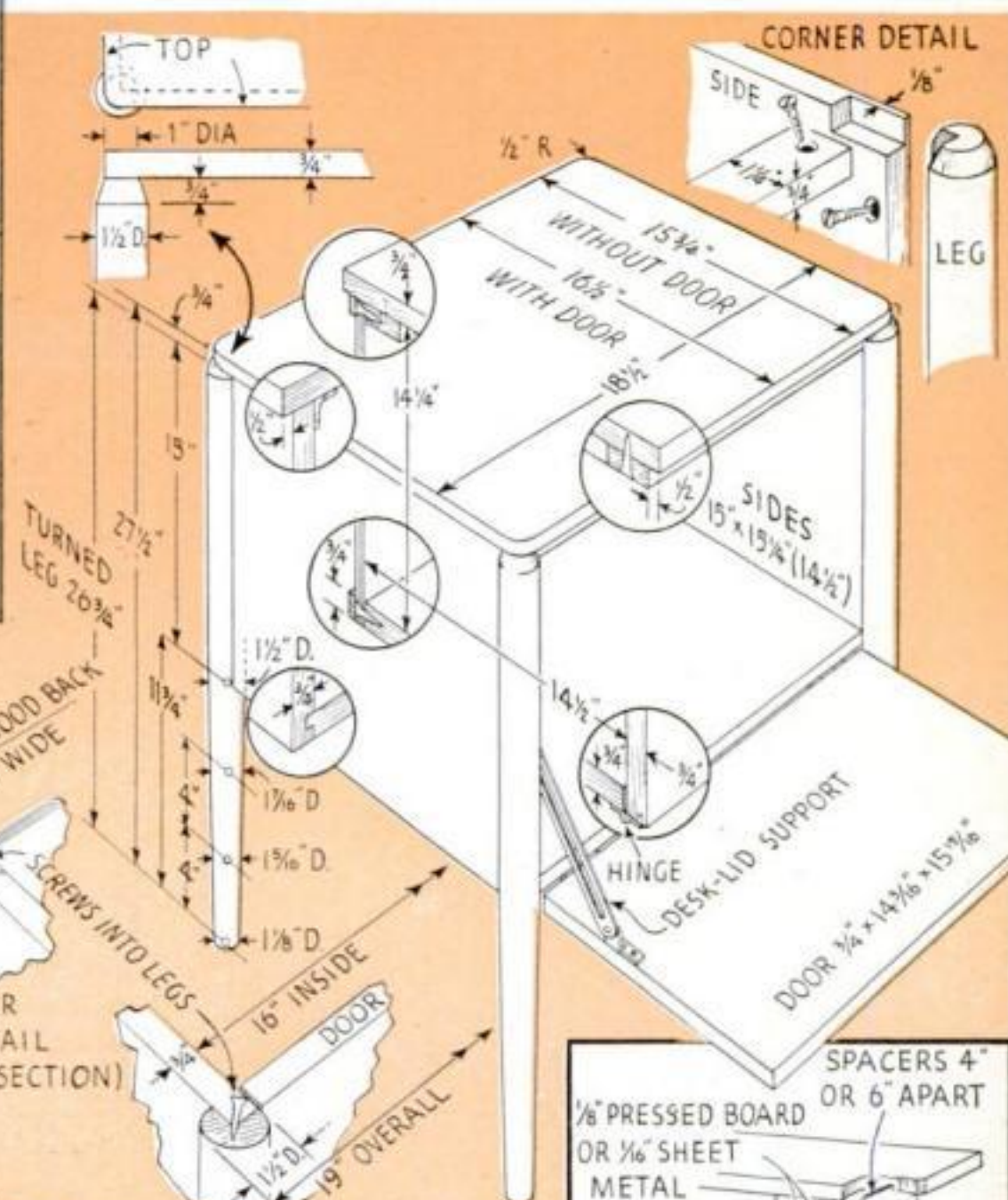


TWO MODERN Cabinets TO HOLD YOUR Phonograph Records

SO GREAT is the popularity of recorded music that it has become a problem in many homes to find a suitable place to keep the rapidly growing accumulation of phonograph records. The best solution is to provide a cabinet especially designed to hold standard record albums.

Two designs are suggested in the accompanying illustrations. The first is a distinctly modern cabinet for a music-loving family that expects to build up a large collection of records. It has a capacity of about 380 records in albums. The compartments may be subdivided, if desired, with spacers 4" or 6" apart to keep the records or albums upright as shown in a detail. The smaller cabinet has room for about 96 records.

Either design can be made in any good cabinet wood. Their modern style, however, makes a light finish especially appropriate, in which case maple, blond



Cut the quadrant from each leg with a dado head. Square end of cut 15" from the top with a chisel by hand

walnut, or birch may be used, as desired.

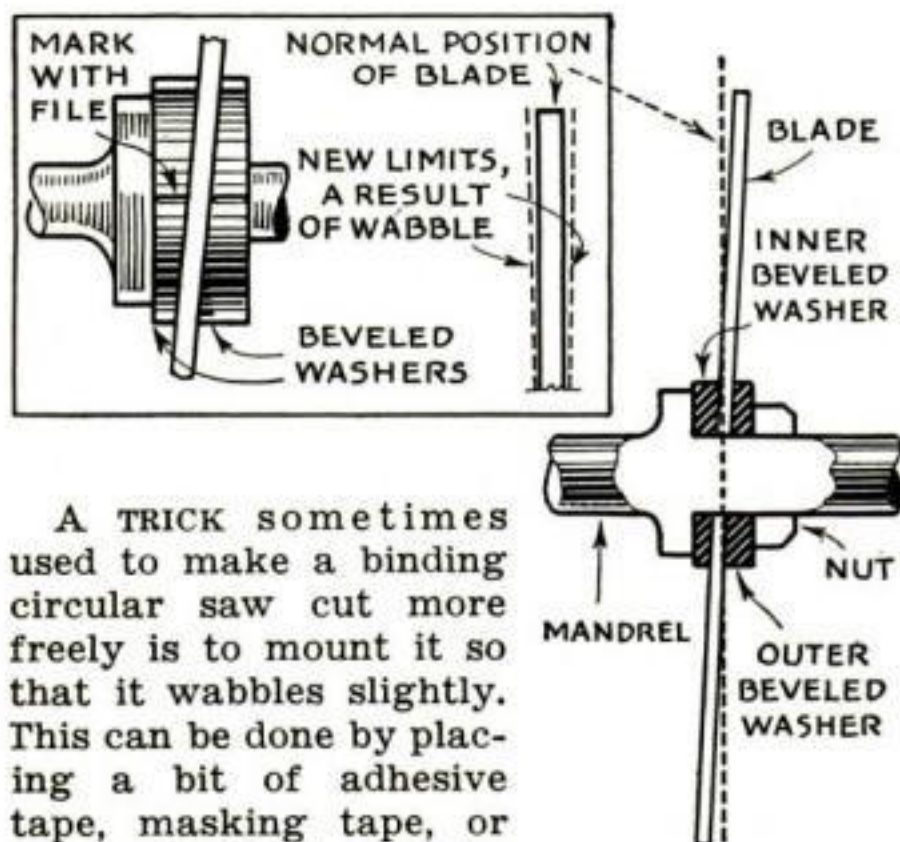
The design of the larger cabinet minimizes the trouble to be expected from shrinkage, as the grain of the principal parts runs in one direction. Because of this, the use of solid wood is permissible, although the wide boards should be glued up from three or four narrow strips to counteract warping. This piece is well adapted for veneering and inlaying, and the top can be inlaid, if desired, with a 10" disk of walnut burl and a 3" diameter lacewood center, representing a phonograph record.

The door can be hung with ordinary butt hinges or hinges of the invisible type. It is held shut with a spring "bullet" catch.

In building the smaller cabinet, the box should be constructed as a unit, and the legs then glued and screwed in place. The top is secured by screws, which pass up through the strips at front and back, and by two metal angles on each side. If the back is to be exposed, glue and brad on strips $\frac{1}{8}$ " by $\frac{3}{4}$ " at top and bottom of rear panel.

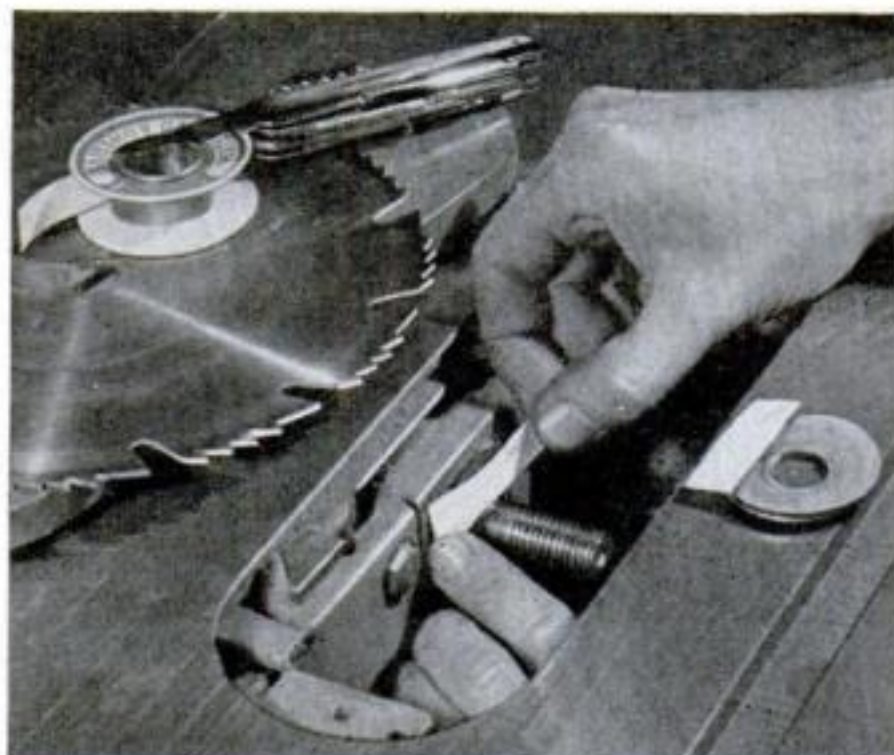
Various modifications can be made of these designs, such as omitting the doors.

Wabby Circular Saw Cuts Without Binding



A TRICK sometimes used to make a binding circular saw cut more freely is to mount it so that it wabbles slightly. This can be done by placing a bit of adhesive tape, masking tape, or gummed label on the shoulder of the mandrel as shown. Then, on the washer that goes against the outside of the saw, a similar piece is stuck. The washer is adjusted so that its high spot is diametrically opposite that on the mandrel. As a result, the saw wabbles slightly when running, thus cutting a wider slot.

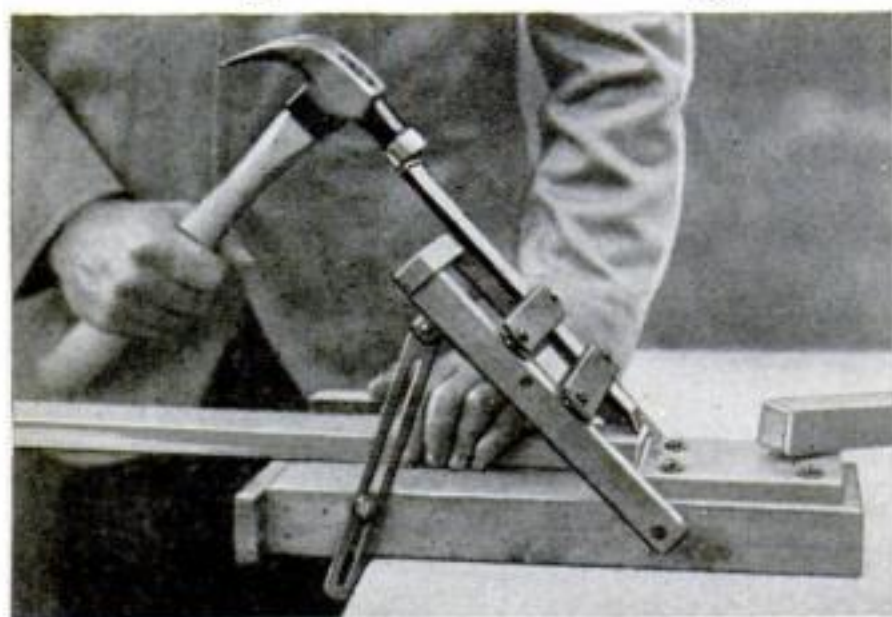
This treatment is particularly helpful with hollow-ground or planer-type saws



that are cutting poorly, but it is only for emergency use and for fairly light cutting.

A better way is to machine a pair of washers or spacers, each having one surface at a very slight angle with the other. These are marked so that their beveled surfaces can be placed in the same plane. Pressure on the saw is then uniform and there is less danger that uneven stresses will be set up. Saws having such a wabbling feature built into them are on the market.

Jig for Trimming Ends of Furniture Squares



Uniform bevels can be cut at any desired angle

CONSTRUCTED from scraps, the device shown is used for beveling or chamfering the ends of pieces of softwood for handmade furniture. The base is a piece of 2" by 4" about 15" long. The adjustable frame is of $\frac{3}{4}$ " oak with two steel straps across the top to hold the chisel. Slotted box-lid supports provide for adjustment to different angles. A piece of hardwood with slotted screw holes serves as an adjustable stop for the work.

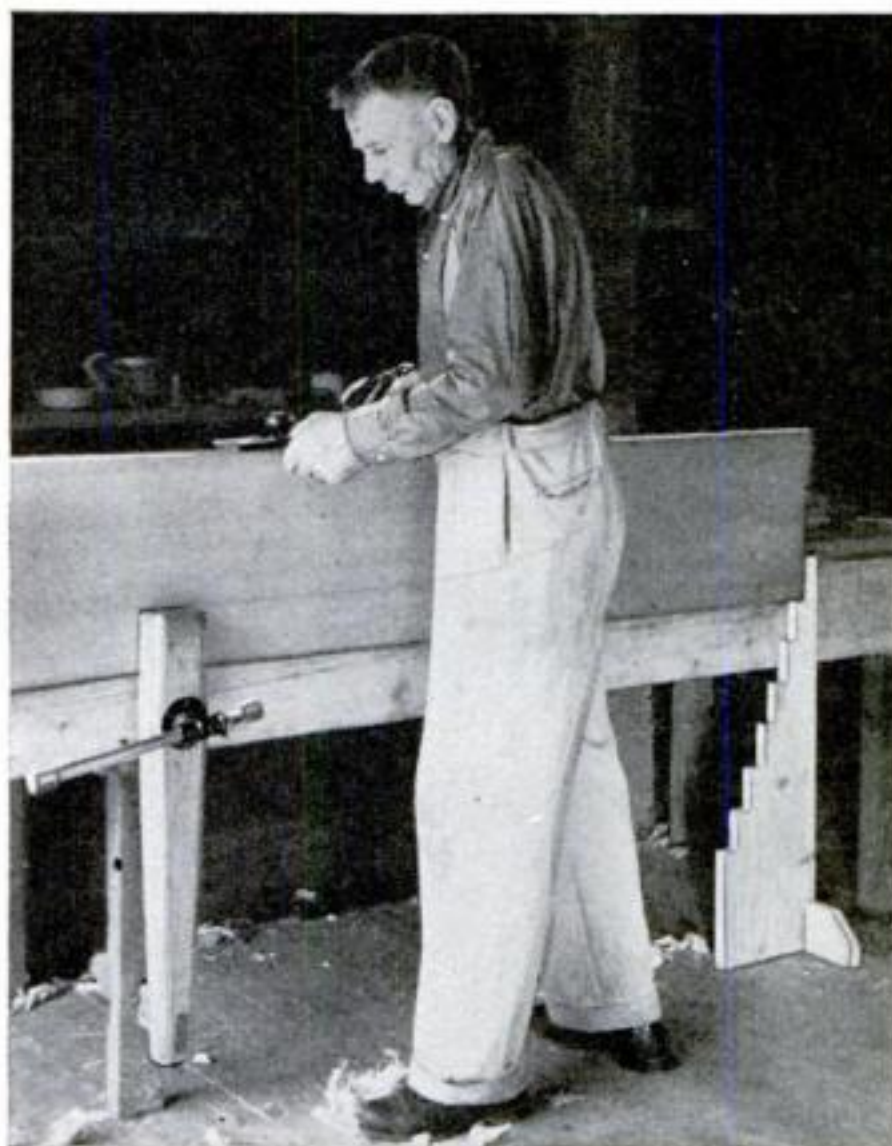
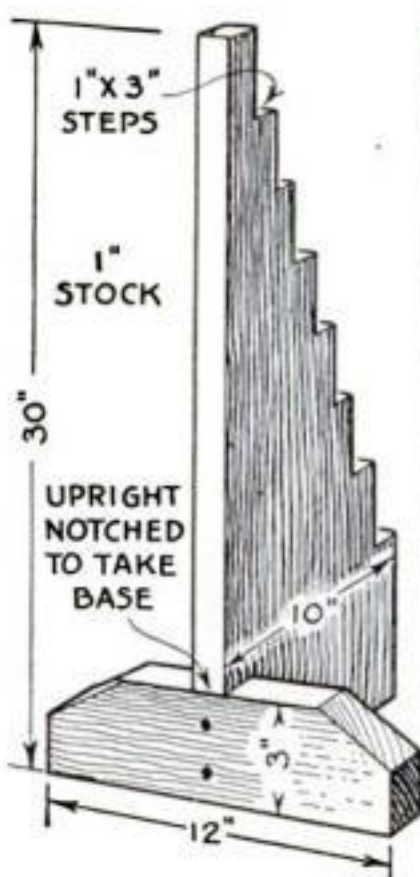
Tool steel, 9" by 1" by $\frac{1}{4}$ ", was used in making the chisel. The cutting end was ground to a 22-deg. angle, then hardened, tempered, and sharpened to a keen edge on an oilstone.—J. C. MONTGOMERY.

Support for Long Boards Being Planed by Hand

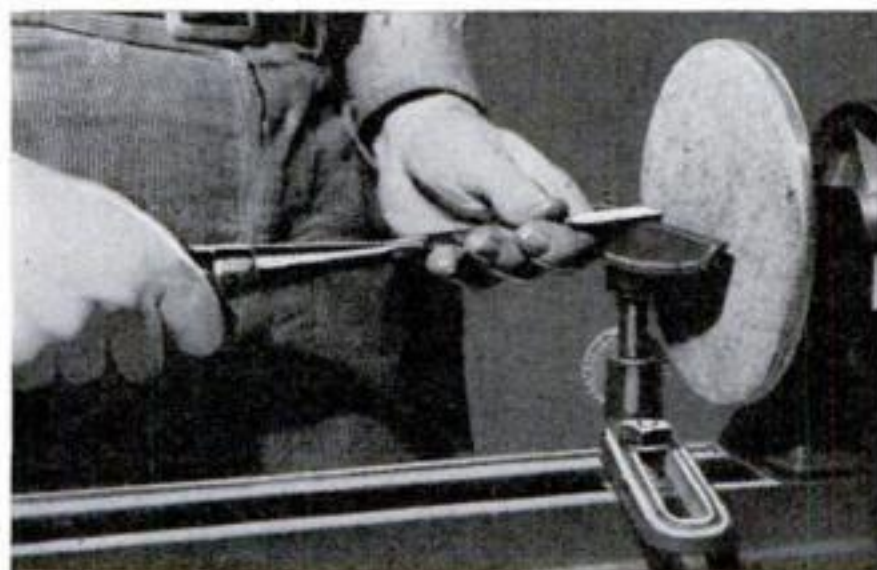
AMONG the various supports used for holding the end of long boards while being planed at the bench, one of the simplest and most convenient is that illustrated. A series of steps are cut out of the upright piece to permit wide work to be held level at different heights. The dimensions given can be altered to suit individual needs.

• • •

WHEN using a step-ladder for repair work, tools and materials may be placed on the top step if strips of $\frac{3}{4}$ " by 1" wood are nailed or screwed around the edge to form a tray. The strips will not prevent stepping on the top step when necessary.



Steps cut in the upright piece allow wide work to be held level at different heights



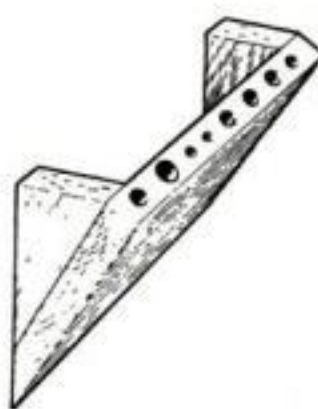
Cork Facing Improves Metal Sanding Disk

IF A SANDING disk is faced with cork, the garnet or aluminum-oxide paper will last considerably longer. A roll of $\frac{1}{16}$ " or $\frac{1}{8}$ " thick cork may be obtained from a mail-order house or craft-supply shop. Brush casein glue on both the cork and the metal disk, apply pressure, and leave to dry overnight. If the sanding disk happens to be a little out of true, use $\frac{1}{8}$ " cork so that it can be turned true after being glued.

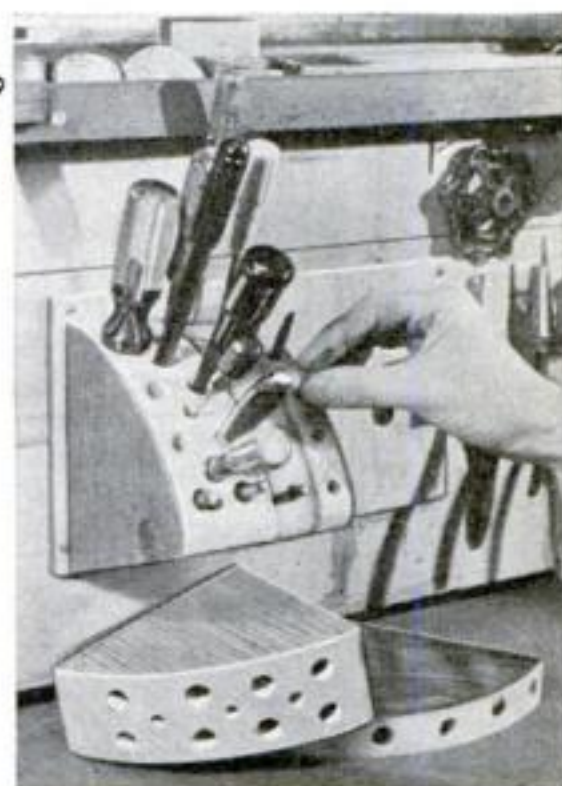
Rubber cement is used to fasten the abrasive paper to the cork. Apply a coat to both surfaces, let dry five minutes or more, apply a second coat to the cork surface, and again let it dry. Then press the disk against the cork surface.—ERIC L. BUSS.

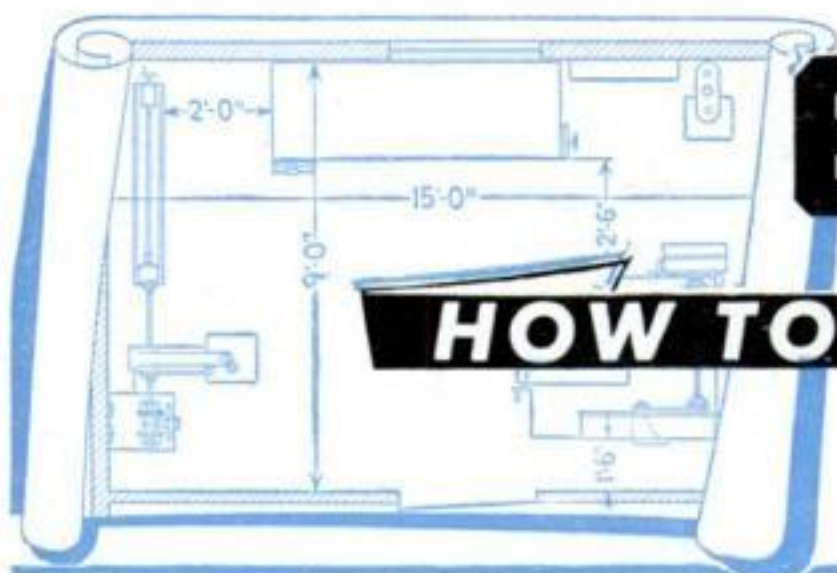
Handy Racks for Punches and Other Small Tools

ONE of the commonest racks for tools such as punches and screw drivers consists of a strip of wood with holes bored at intervals along one edge. Instead of mounting such racks flat, tilt their upper edges outward so the tools can be inserted and extracted at a convenient angle, or bore holes in a series of segments cut from circular disks and mounted side by side. Each segment should cover about 60 deg. of arc, with holes spaced every 10 or 15 deg.



More tools can be stored in a given area when racks of these types are installed





Economical

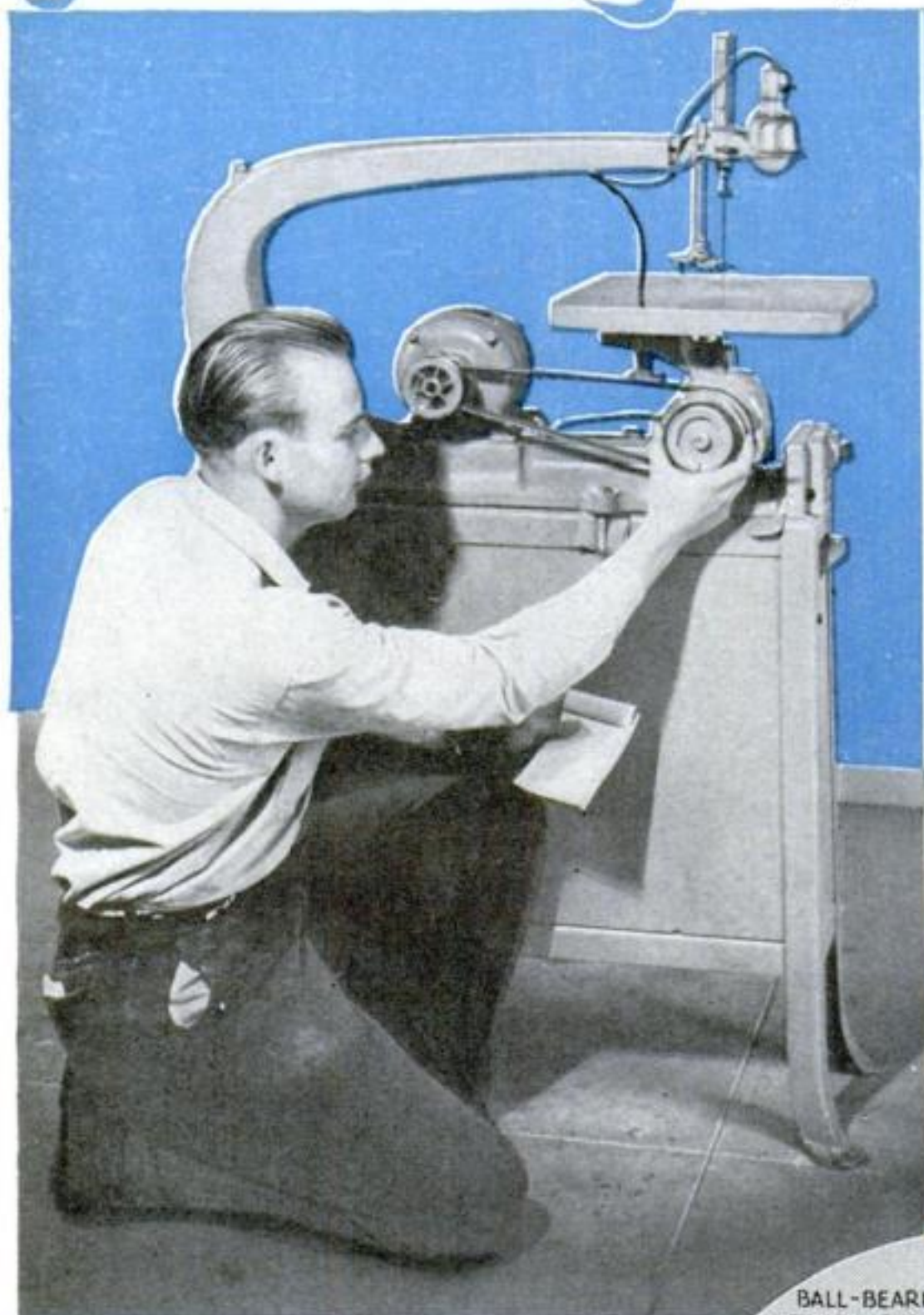
HOW TO MAKE ONE MOTOR

By EDWIN M. LOVE

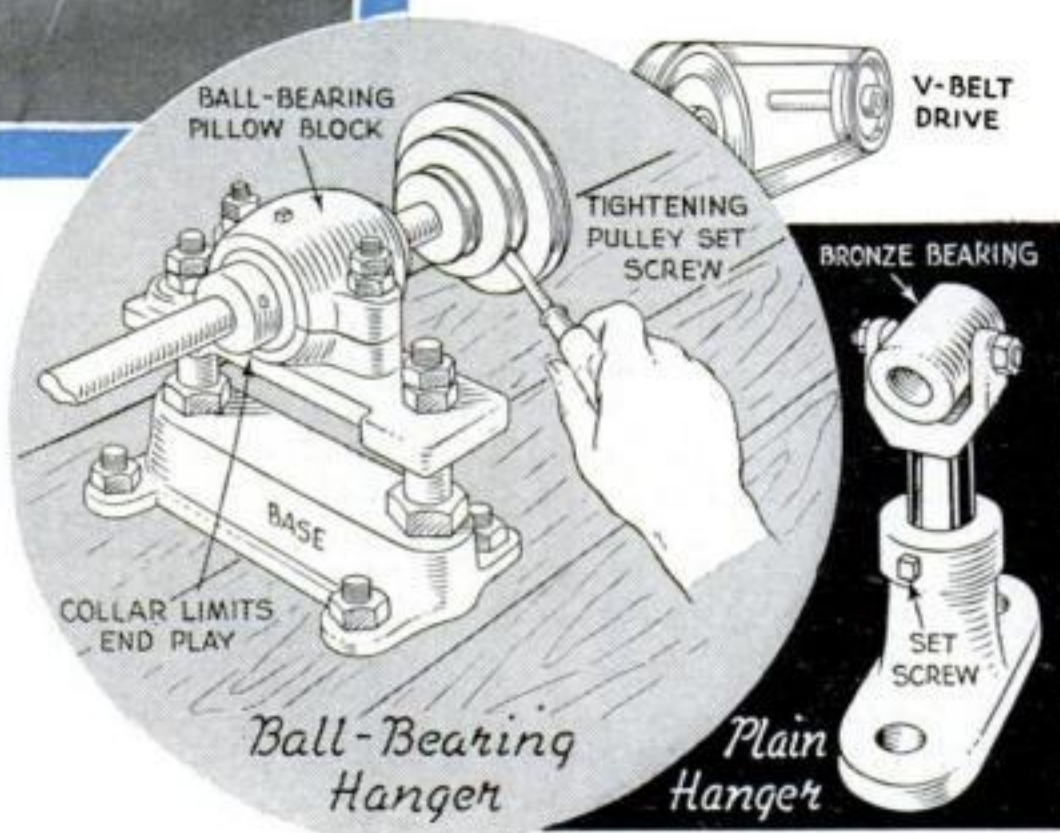
A MACHINE is an individualist, usually giving its best when driven by its own motor. A flip of the switch, and the lathe whirrs or the drill bites into the work.

With the possible exception of a circular saw and jointer combined in one drive, the maximum output and convenience are achieved in the home workshop by allotting a motor to each machine. All available power in the motor is delivered to the pulley, with none wasted in belts and bearings along the line shaft. There are no belts to be removed or replaced, and no heavy motor to be dragged from one power tool to another.

In actual practice, however, many home workers have to make one motor serve for several machines. It is sometimes argued, in fact, that a line shaft is an advantage because one powerful motor can be used instead of several small ones, thus saving on the purchase price and speeding up



ROBERT JAACKS, WHO IS EQUIPPING his home workshop on a monthly budget of \$15, checks the speed of his scroll saw by marking the pulleys to count the turns of each. He now has a good assortment of hand tools, and a small bench and wall cabinet. His shop is equipped with an 8" circular saw, a 4" jointer, and a 24" scroll saw. Among the accessories are a saw-table extension, basket guard, and dado head. He will celebrate the first birthday of his shop by the purchase of an 11" wood-turning lathe with a good set of turning chisels and a sanding disk

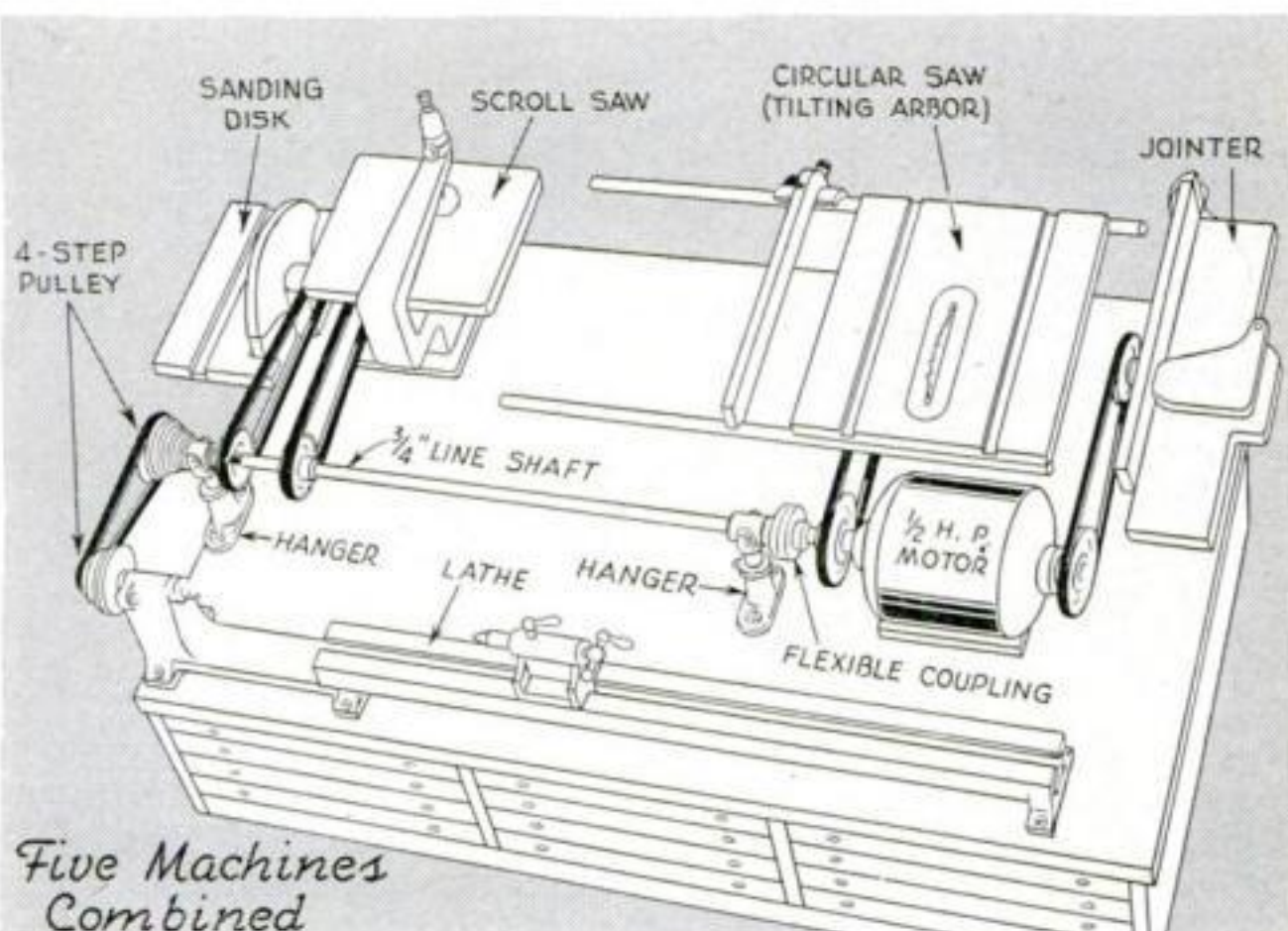


Workshop Layouts

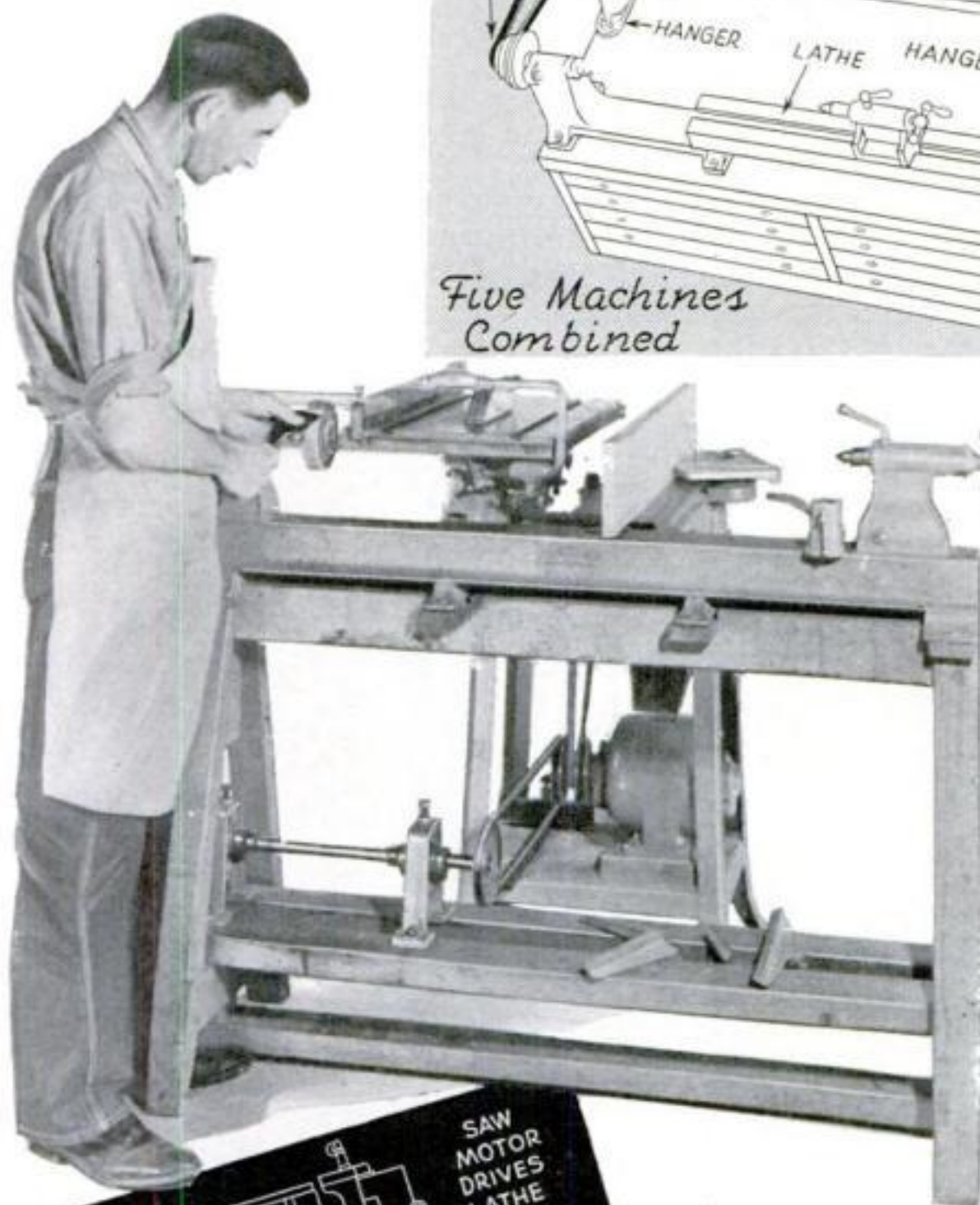
DO THE WORK OF TWO OR MORE

At the right is a space-saving layout of five machines of standard size on a bench top 44" by 56"

Driving a lathe from the motor of a combination saw and jointer. Note the board on the jointer, which was placed there to show that it clears the lathe bed without any difficulty



Five Machines Combined



heavy work on the circular saw. Unfortunately, half-horsepower motors are the largest permitted on lighting circuits. This size is none too big for the circular saw, and if it is required to drive shafting as well, the saw is the loser. Besides, the shaft requires power when idling and runs up the bill for electricity. These, in brief, are the pros and cons of individual and combination drives.

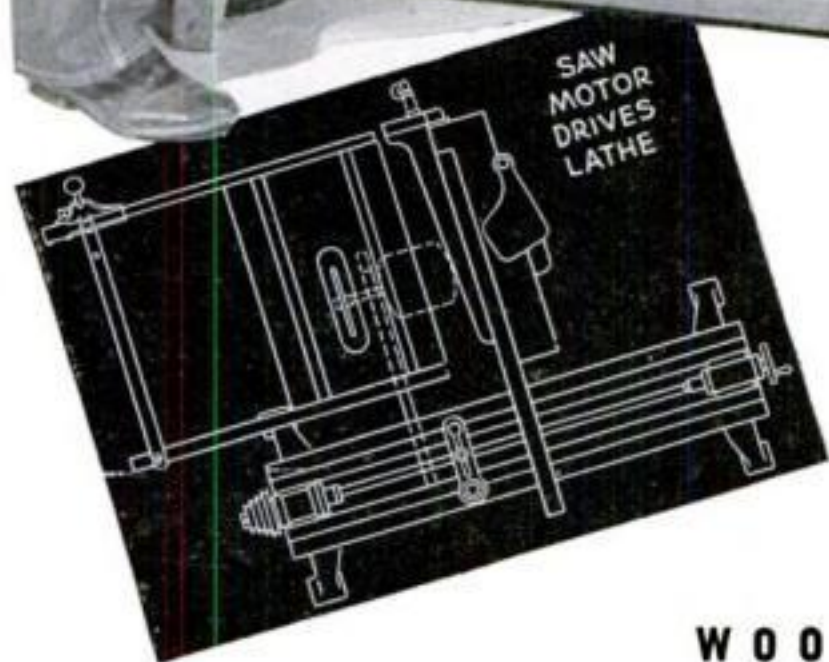
What are countershafts and line shafts?

Countershafts or jackshafts are short units provided with pulleys that serve to reduce or increase speed of rotation, or to provide for a number of speeds in one machine. A line

shaft is longer and designed to operate several machines. A line shaft is necessary for gasoline drives, as it would be impractical to have an engine for each machine.

If a power tool has a countershaft, couldn't other machines be driven from it?

This is quite possible and one good way



to economize with motors. Most wood-turning lathes can be fitted with countershafts; in fact, they must be if metal turning is to be done.

The drive for the lathe will also operate a scroll saw or a band saw, or both. The scroll saw can be placed at the head of the lathe, with a belt direct from the shaft, or a shorter belt from the headstock may be used. If very large faceplate turning is often done at the left end of the lathe headstock, it would be wise to have a belt long enough to permit the saw to stand entirely clear of the lathe. A band saw would be placed farther back or behind the lathe to obtain sufficient space.

The machines could be assembled on a bench wide enough to take all, or on one built in "T" or "L" shape. It is easy to mount the lathe low enough so that it will not obstruct long or wide lumber being worked on the saws. An example of how a lathe can be placed in such an arrangement is shown on the preceding page.

The higher-powered circular saw motor can drive a lathe as well as a jointer. Stand the lathe at the back of the saw, belting its countershaft to the motor. For cutting very wide stock on the saw, the headstock of the lathe must be removed, which is easy if a special wrench to use from below, or from the end, is made. The lathe could also be pulled endwise to clear wide stock.

How may more machines be arranged for driving from one motor?

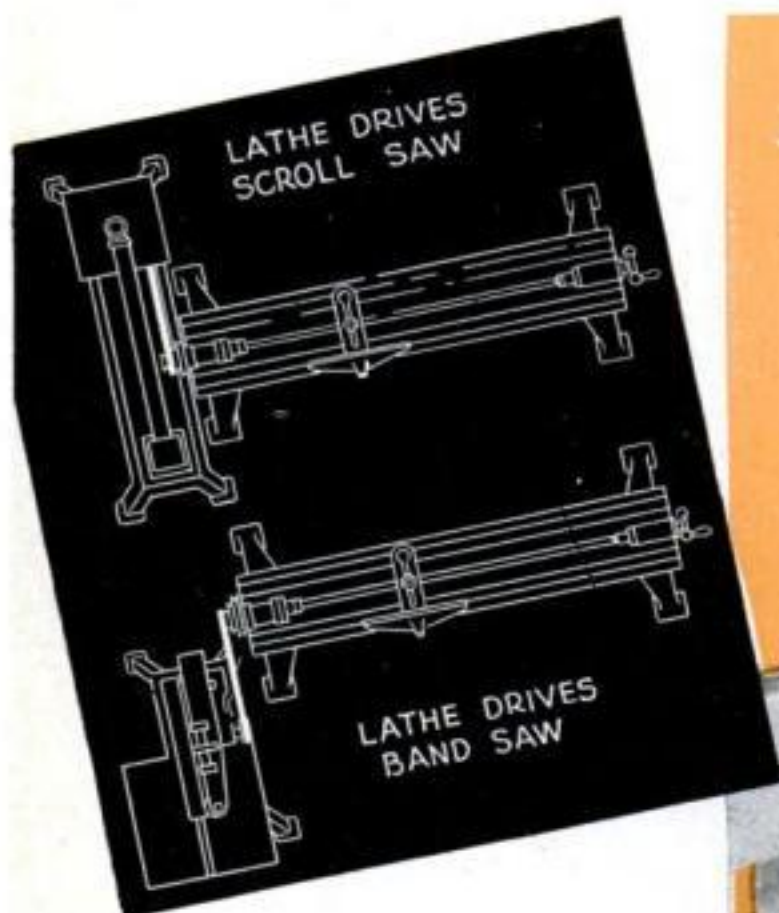
Halford R. Thomas, of Alhambra, Calif., has an ingenious set-up of six machines mounted on an old washing-machine base. Casters allow the group to be pushed around as desired, so that long boards being cut on the saws can be steered through the door.

Another good arrangement, which combines five standard-size machines, is shown in a drawing on a preceding page. These are all mounted on a bench top about 44" by 56". The motor is connected directly to the line shaft, but a little change would allow the use of a longer shaft belted to the motor, giving additional speed at a little more cost, and permitting the saw and jointer to be used without need of driving the shaft.

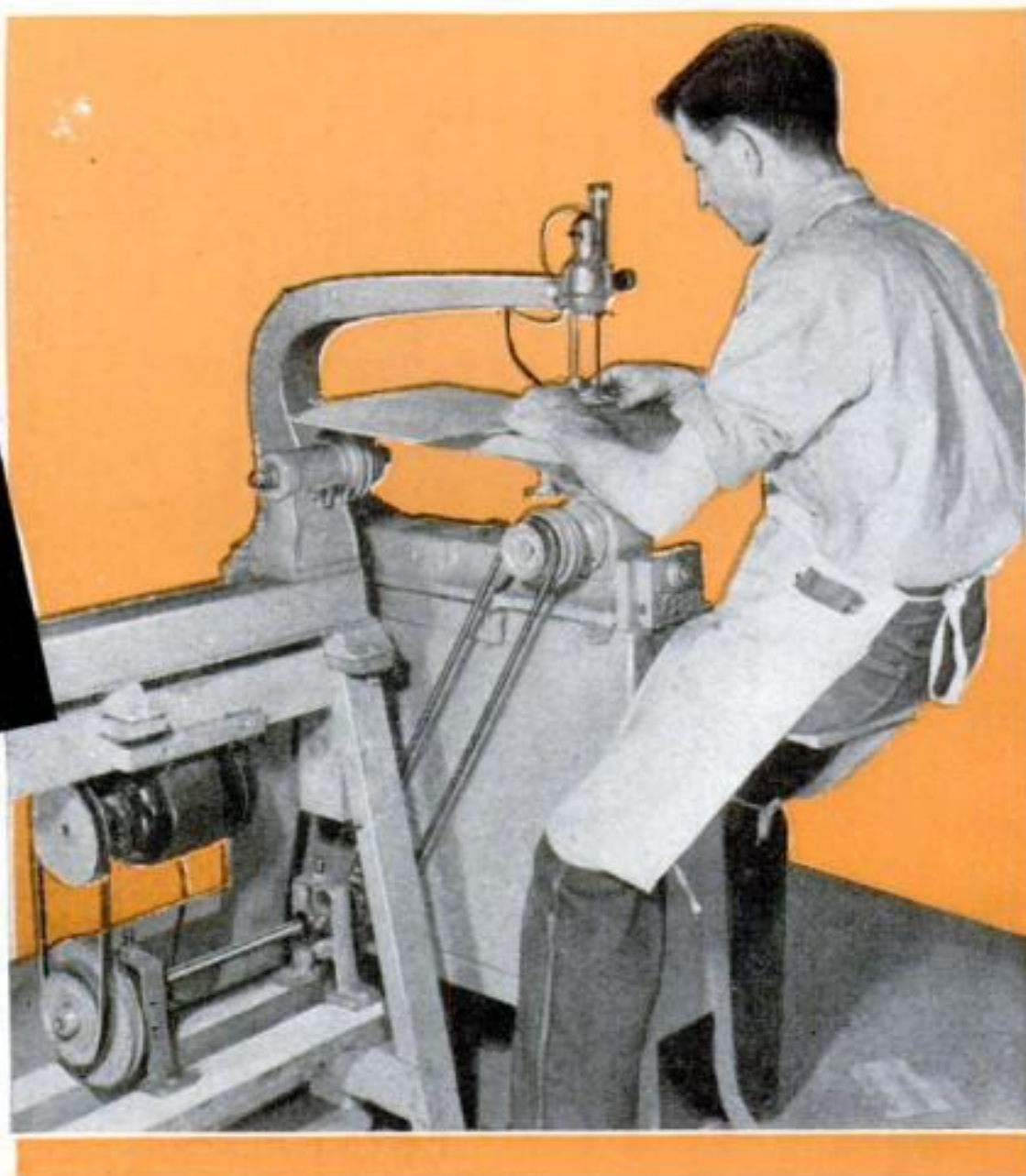
Is shafting difficult to install?

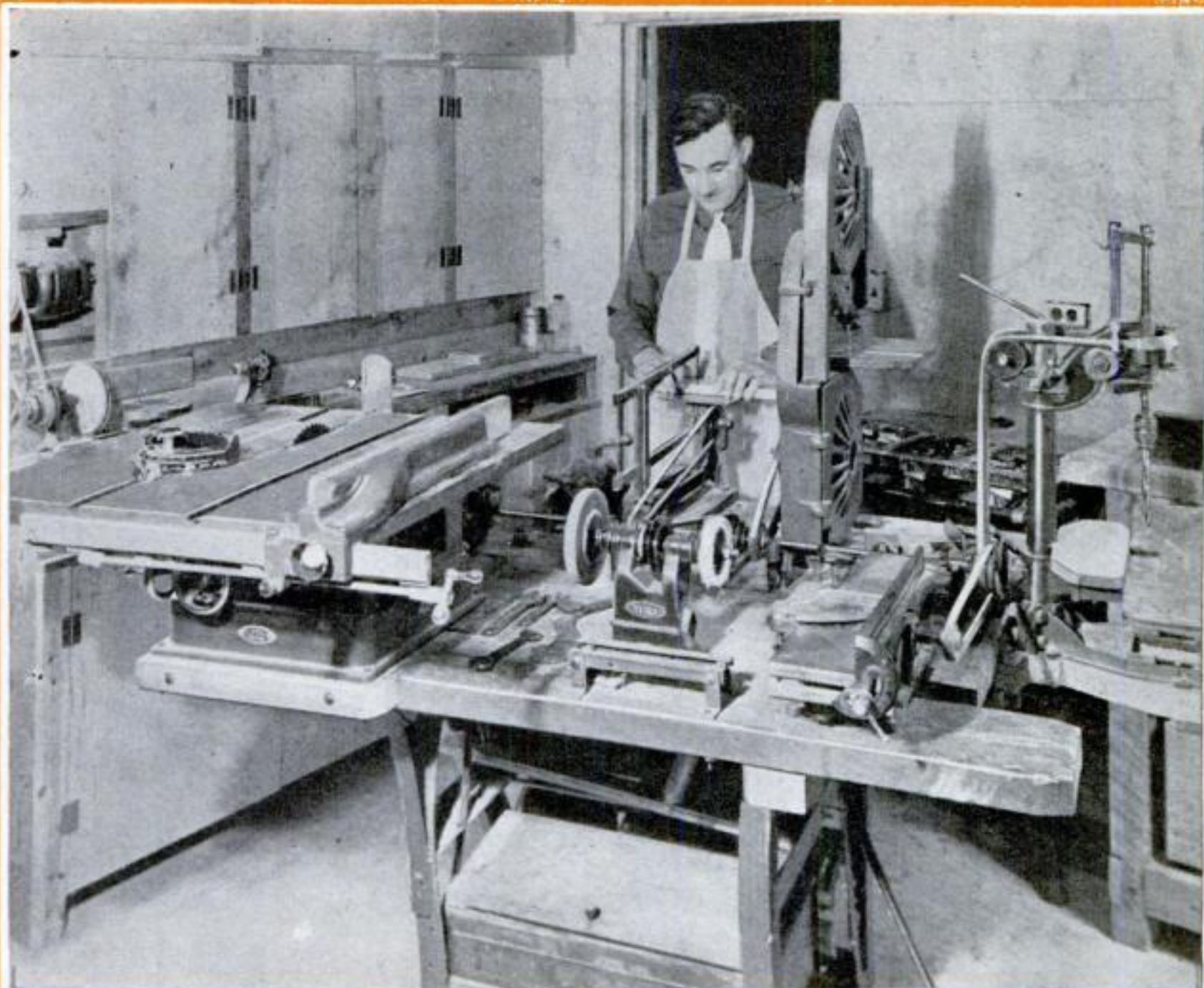
No, the installation is fairly easy. A length of shaft will act as a straightedge. Slip on the needed hangers, prop the shaft in position, and screw the hangers in place, bringing the bases to a line. Tighten the set screws for the height adjustment of the end bearings and try the shaft with the fingers. Binding indicates twisted bearings. The intermediate hangers are then adjusted. If the columns are not adjustable for height, the bases may need shimming.

If more than one shaft length is required,



Mr. Love demonstrates the use of the lathe countershaft to drive a scroll saw. With a longer belt, the saw could be set back far enough from the lathe to allow the outboard turning of very large faceplate work





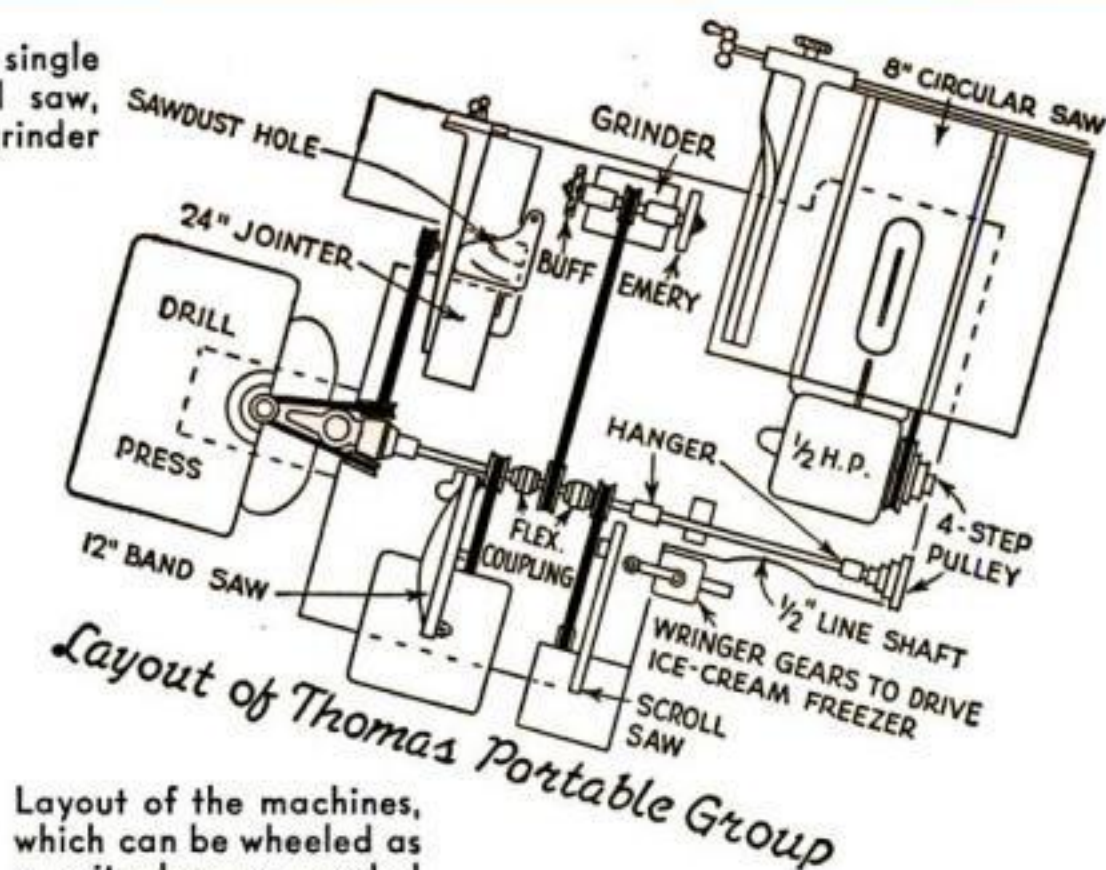
In Halford R. Thomas' shop, a single motor drives circular saw, scroll saw, band saw, drill press, jointer, grinder

use a coupling, preferably a flexible one, which will take care of slight misalignments. Use clamp-on collars to limit end play.

What do shafting and accessories cost?

Shafting, ground true, can be bought for as little as about 12 cents a foot for $\frac{1}{2}$ " diameter in 24" lengths, suitable for driving light machines. For heavy work, use $\frac{3}{4}$ ", costing around 25 cents a foot. Solid couplings in these sizes are 18 and 29 cents up, and flexible rubber-cushioned couplings 25 and 40 cents. Bronze-bushed hangers are around 90 cents and \$1.15; self-aligning ball bearing hangers, $\frac{3}{4}$ ", about \$4.70. Bronze bushings need frequent oiling; ball bearings require only occasional oiling and waste less power.

V-belts are used almost exclusively in the home shop. In general, they are more ef-



Layout of the machines, which can be wheeled as a unit wherever needed

ficient and less wearing on the bearings than are flat belts. They cost as little as a cent an inch for widths of $\frac{1}{2}$ ". Pulleys are available in many sizes and prices, and are either die cast or pressed from sheet steel. Most of them are locked on the shaft with set screws, although in larger sizes keys are often used. With such a choice of pulley

sizes and belt lengths, machines can be run at any chosen speed and placed wherever desired.

Can countershafts be used vertically?

Yes, if equipped with ball-thrust bearings to carry end loads. Such arrangements can be used for driving drill presses and shapers, but they must be mounted on rigid uprights. To be driven from horizontal shafts, they must be equipped with miter gears or with a belt bent over a pair of pulleys to bring the belt horizontal. The expense and trouble involved usually offset any saving effected by not buying a motor.

How are pulley sizes figured?

Roughly, rotation is proportional to diameter. A 2" pulley turns about twice as fast as a 4" pulley belted to it. For more accurate figures, subtract the thickness of the V-belt from the pulley diameters, since the belt bends near the center of the thickness. There is a little variation, due to belt tension, speed, and load.

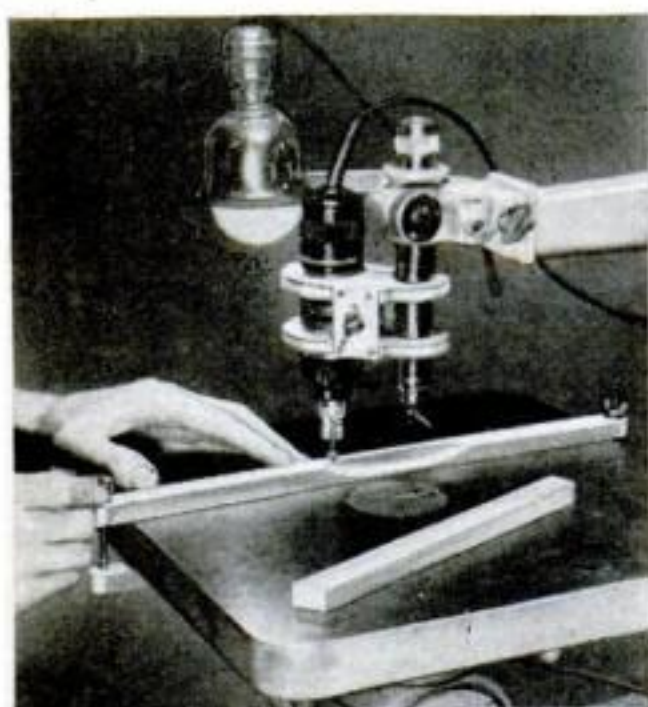
V-belts need not be drawn tight, as they grip with a wedging action that increases according to load.

(TO BE CONTINUED)

If a truck and handles are made as shown below, it is an easy matter to shift the machines as required for various jobs

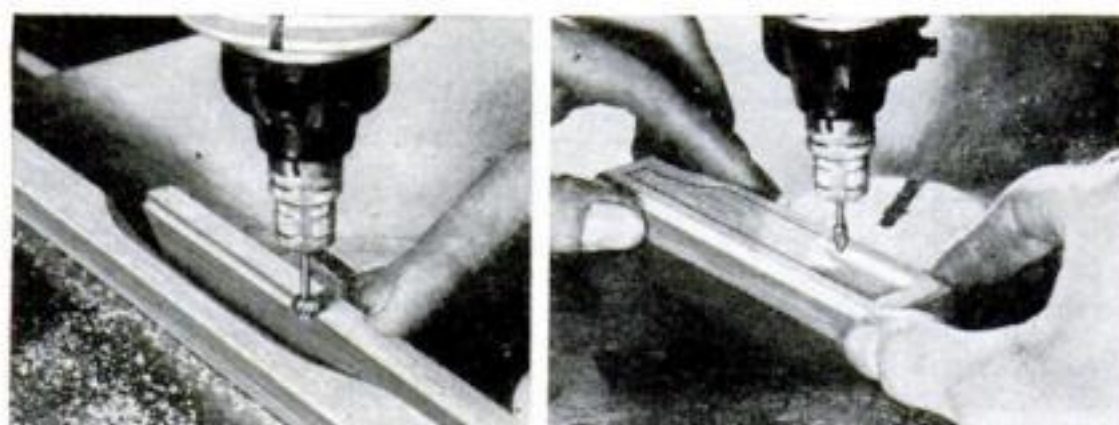
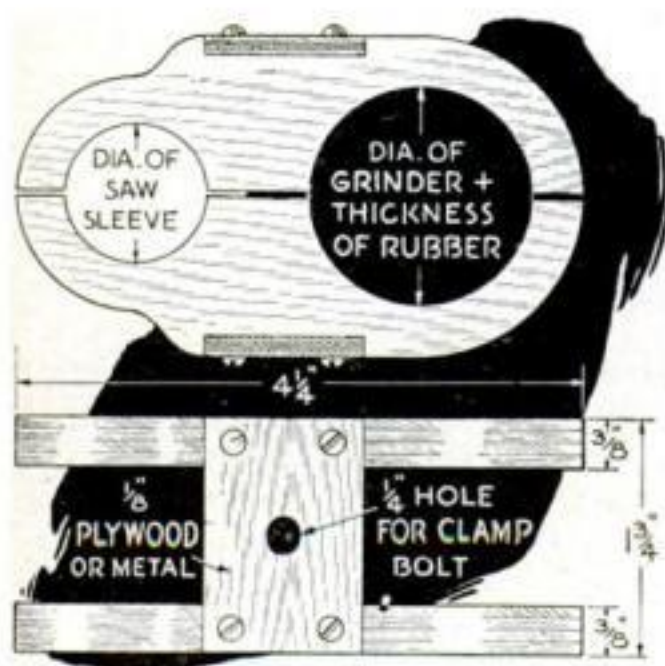


Hand Grinder Used on Scroll Saw for Shaping

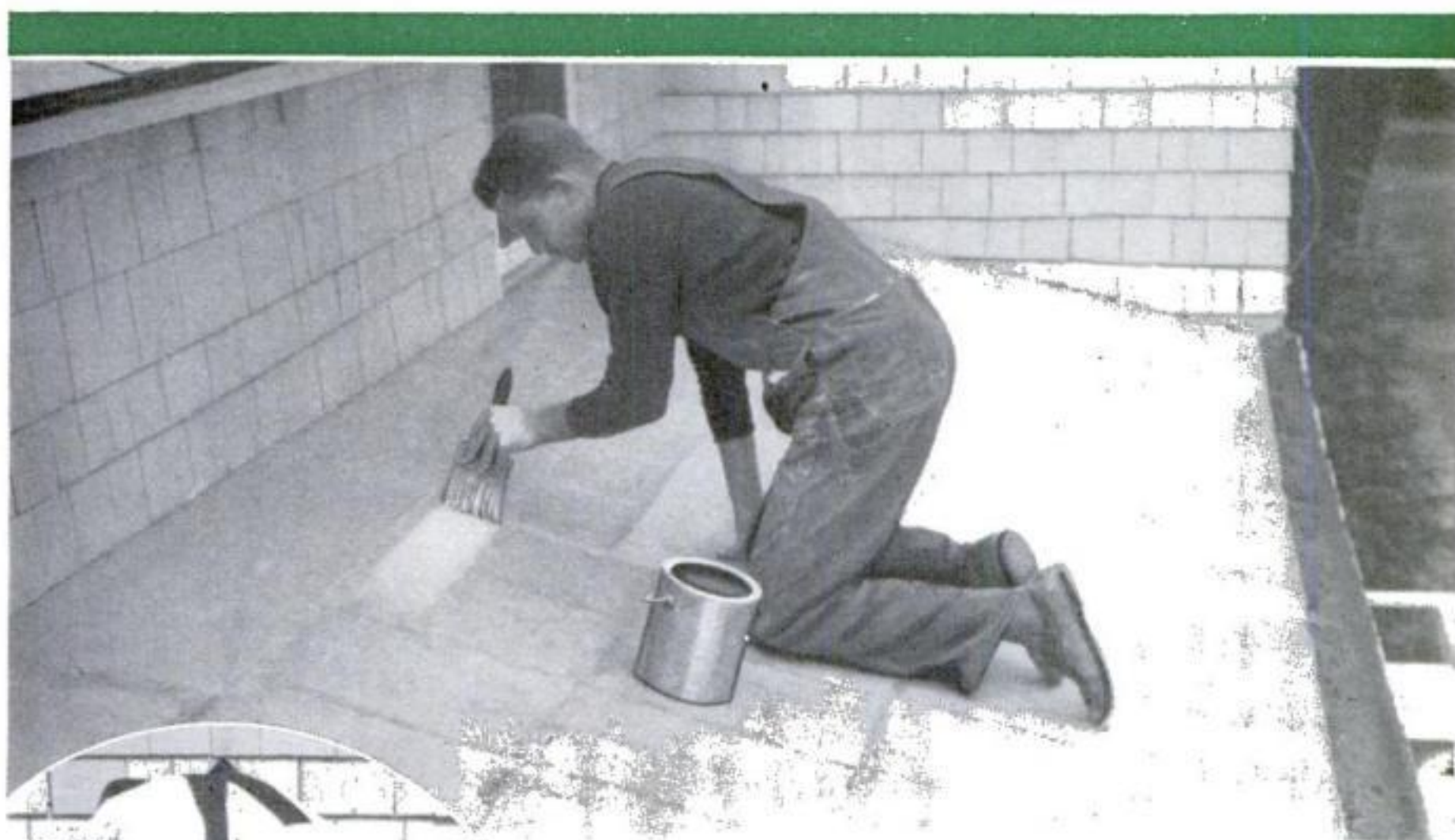


BY CLAMPING it to the saw sleeve of your scroll saw, a small high-speed hand grinder can be mounted for delicate shaping, routing, sanding, and the like. The size of the plywood bracket for attaching the grinder will vary, but approximate dimensions are given. The two main clamps are cut from $\frac{3}{8}$ " five-ply wood, allowance being made for the thin rubber that is glued to the gripping surfaces. Two metal or plywood connectors are drilled for a $\frac{1}{4}$ " bolt and are screwed to the clamp plates. A wing nut locks the unit in place.

A two-piece wooden guide fence is clamped to the saw table. If a small section of the fence is cut away, it will allow for the cutter when lowered. Vertical adjustments can be made either with the tension adjustment screw or by moving the bracket itself. A slight pressure will hold the grinder rigidly.—H. HANSCOM.



The motor tool clamps on the scroll-saw sleeve. For straight shaping or routing, a wooden fence is attached to the table



HOW TO PATCH AND PAINT Old Tin Roofs

Unbleached-muslin patches are applied with roofing paint over all spots that have been cemented

holes with marine deck crack filler or other suitable plastic cement compound. Without waiting for it to dry, apply a thick coat of roofing paint over the cement; and to re-enforce this, lay on an oval patch of unbleached muslin. Smooth it out with the paintbrush while coating the cloth with paint. Allow such patches twenty-four hours to dry before painting the entire roof.

For the protection of gutters, genuine asphaltum-base paints thickened with short fiber asbestos may be used. Small leaks can be stopped with this heavy type asphaltum paint, but where badly damaged areas are evident, these should be coated first, then re-enforced with cloth patches, and immediately recoated.

Where new metal roofs are to be laid, the metal should be back primed with a modern rust-inhibitive metal primer before being seamed. The finished roof must be primed with the same primer before being painted. The newer forms of molybdenum and copper-bearing galvanized sheets are, of course, especially resistant to weather and rust, but they, too, should be given a coat of galvanized-metal primer and one or two coats of any of the newer and better synthetic-base roof coatings.

By RALPH G. WARING

TIN roofs, which are frequently found on old houses and other buildings, will last almost indefinitely if properly maintained. The roof illustrated above was laid in 1868 and should be good for another quarter of a century at least.

Roofs should be regularly inspected in the fall and spring. When it is necessary to re-finish a tin roof, all seams, especially of the flat type, should be scratch-brushed and scraped clean and free of scaled, blistered, or cracked paint. The rough edges should be feathered down with coarse sandpaper to the clean metal. These areas should be immediately primed with a rust-inhibitive (preventing) paint and allowed to dry twenty-four hours.

If a nail has worked its way up through the metal here and there, it should be driven down with a large nail set. Level off the



Although inexpensive, this toy will delight any small girl

Child's Doll Bed Easily Made from Empty Orange Crate

AN ORANGE crate can be made into a doll bed by removing the middle crosspiece and also the top sidepiece on each side. Then saw the head- and footboards to suit your fancy, and glue a spool under each corner for legs. If desired, reinforcing strips of wood about $\frac{1}{2}$ " by $\frac{3}{4}$ " may be fastened to the sides of the bed at the top, and also under the bottom.

Sandpaper the bed thoroughly, apply a couple of coats of enamel, and add a small "decal" transfer to the headboard.—B. P. S.

Butter-Dish Lid Covers Opened Stamp Pad

TO AVOID having to open his stamping-ink pad frequently each day, one shipping clerk uses the glass cover from a ten-cent butter dish to protect the open pad from dust and keep it from drying out. The cover can be lifted off and replaced in much less time than it takes to open and close the tight-fitting lid of the pad.



WANTED . . . FARM TRACTOR HINTS FOR HOME WORKSHOP SECTION

If you have developed any especially good methods of repairing and maintaining farm tractors, send brief, illustrated articles describing them to this magazine. Cash is paid upon acceptance for all available material.

SOLDERING PASTE

[FORMULAS]

Petrolatum, plain	3 oz.	Zinc chloride	1 teaspoon
Sal ammoniac	1 teaspoon	Water	4 teaspoons

Heat the water, stir in the salts until dissolved, then add the petrolatum or petroleum jelly, which is sold under various trade names, and boil slightly. Let cool before use. Apply to well-cleaned metals as a flux for solder. This is a noncorrosive flux for electrical work, provided all spliced joints are taped afterwards.

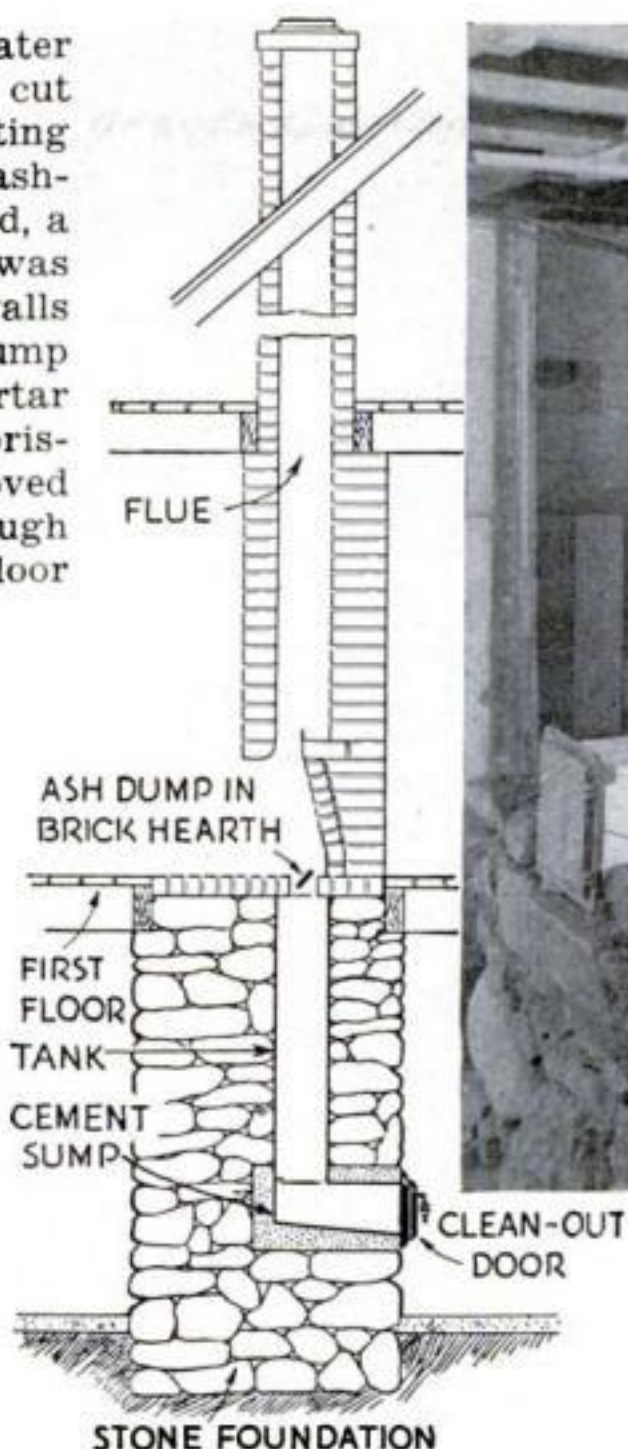
POPULAR SCIENCE MONTHLY SHOP DATA FILE

Hot-Water Tank Lines Fireplace Ash Dump

A DISCARDED hot-water tank with the ends cut off was used in constructing this improved fireplace ash-dump chute. As illustrated, a collapsible wooden form was set up for casting the walls and ceiling of the sump chamber. After the mortar had set, the boards comprising the form were removed by pulling them out through the clean-out door. The floor of the chamber was then cemented in flush with the door sill.

Located directly over the chute, the ash dump operates through an opening in the brickwork of the hearth. Where the bricks span the open top of the chute, they are supported on short lengths of angle iron.

The tank provides a safe, fire-tight lining for the shaft, and the smooth metal wall permits ashes to drop freely from the hearth to the clean-out door.



Placing the hot-water tank. Note collapsible form for casting walls of sump chamber

Liquid Glue Applied with Ear Syringe

LIQUID glue may be neatly applied to any surface with a small ear syringe. The mouth will become sealed of its own accord, but the dry glue at the tip can be instantly removed by squeezing.



Measuring Cup Prevents Overfilling Lanterns

IN FILLING oil lanterns, the use of a measuring cup will prevent wasting kerosene by overfilling. Any can, jar, or bottle which holds the same amount of oil as the lantern will serve the purpose. There is then no need for pausing to watch the rising oil level.—J. M.



Keeping Glass from Sliding

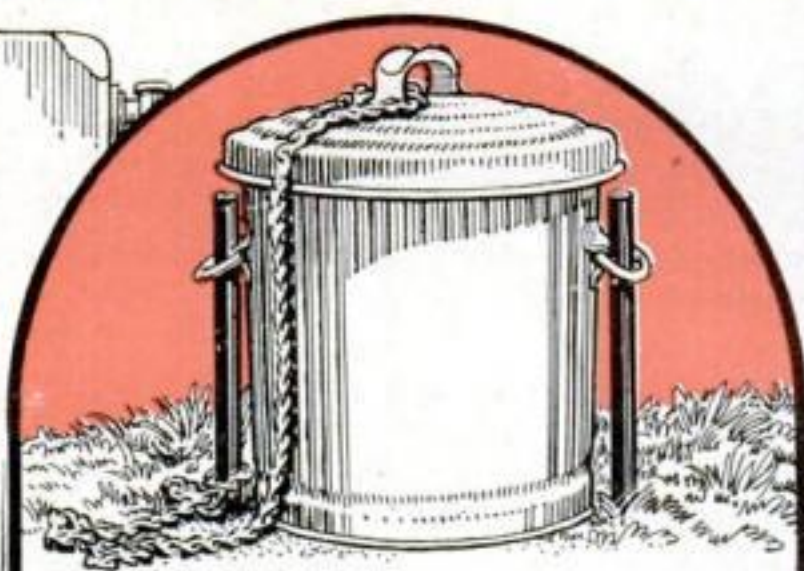


Sometimes a plate-glass top slides around on a desk or table top. When this happens, it may be stopped by placing a piece of transparent cellulose tape, folded with the sticky side out, under each corner as shown in the sketch at the left.

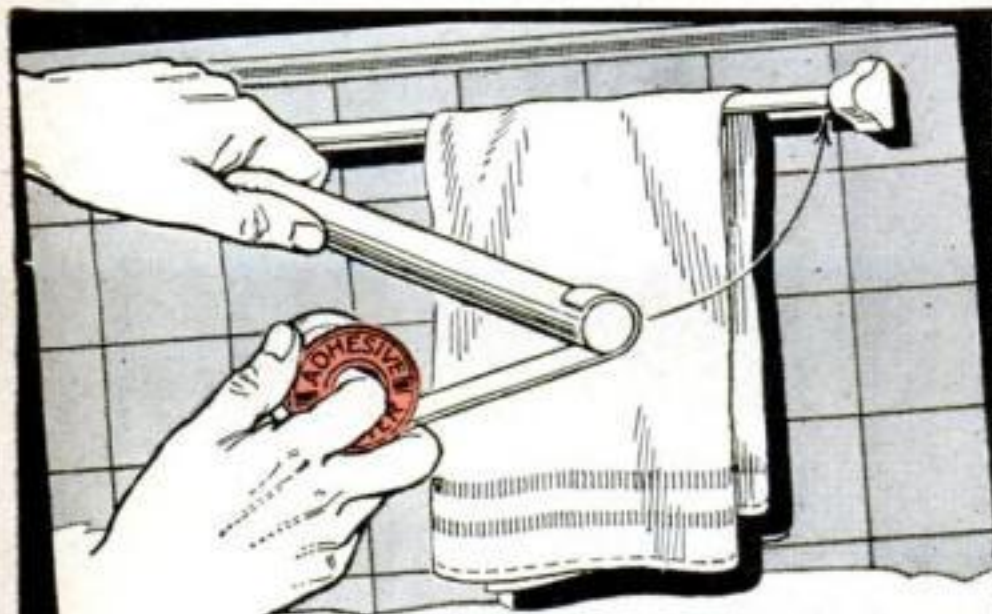
KEEPING THE



Frayed edges of a steel-wire brush can be kept from injuring fingers by stretching a rubber band, cut out of an old inner tube, around the base of the bristles



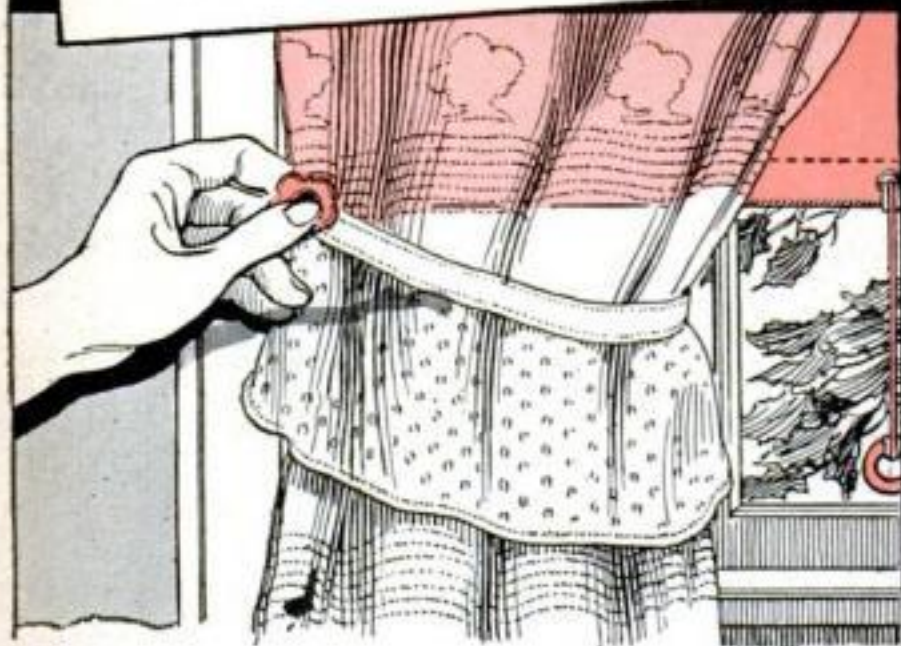
Two pieces of $\frac{1}{2}$ " pipe pounded into the ground to take the handles of a garbage can will keep it from being knocked over. The cover is chained



Towels will stay on racks of the loose-bar type more easily if adhesive tape is applied to the ends to prevent rotation in the bracket sockets



By bending its wire bail to form two hooks, a small bucket can be hung on the clothesline and used to keep clothespins easily accessible



When hanging curtains requiring tie-backs, the window shade can be used as a guide to line up the two pins. Simply draw the shade to the proper height and push the tie-backs in place. This eliminates trying to sight across by eye



To prevent the upper rim of a waste basket from marring your furniture, such as a desk, attach a strip of sponge-rubber weather strip or adhesive rubber cushion to the rim. This acts as a bumper

HOME SHIPSHAPE



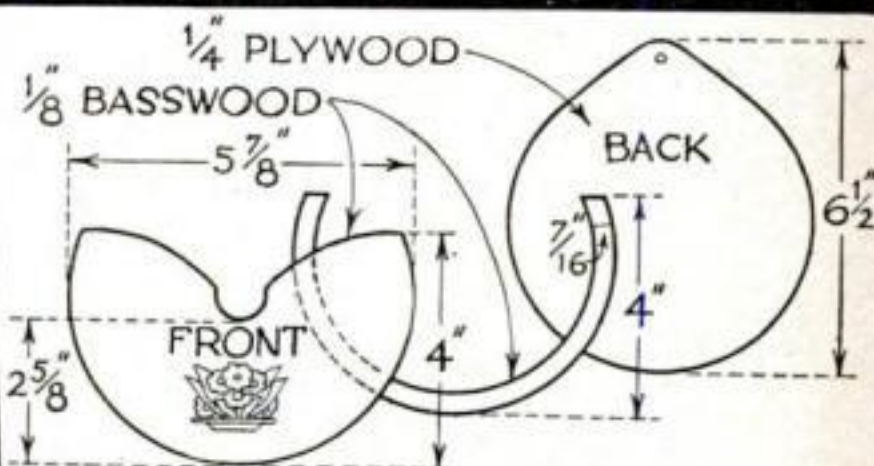
When shoe leather is scuffed, lift up the loose piece, apply clear cellulose cement underneath, and press toward the edges with your thumb nail. Scrape away excess cement



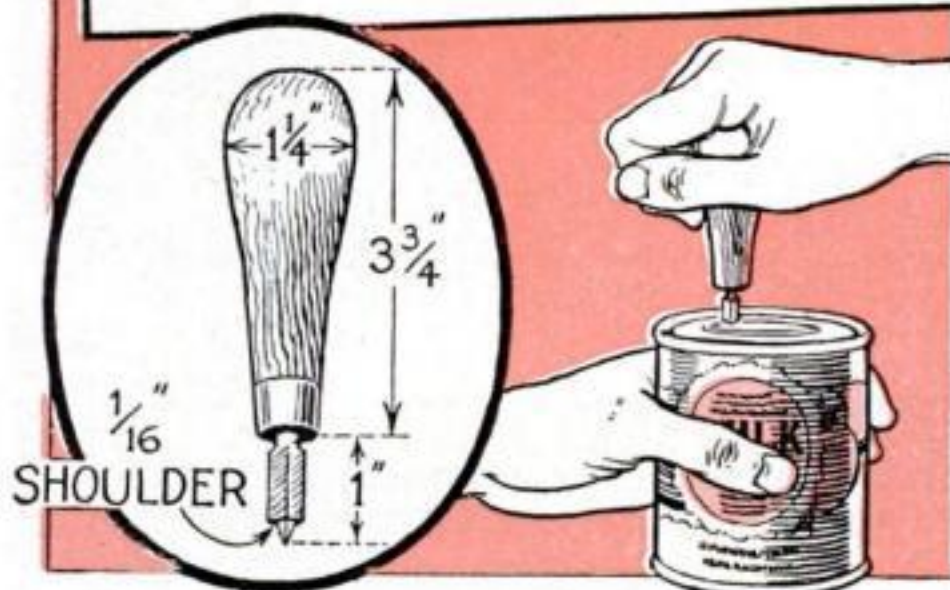
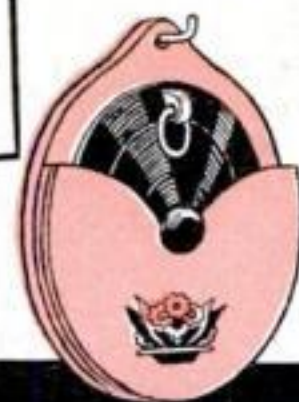
A window washer can keep his drying towel at hand by knotting one corner and inserting the knot in his hip pocket. It will not fall out



There is often room in a kitchen cabinet to install a sliding board having a hole into which a bowl will fit. Then one hand is free while the other stirs the contents



Easily jig-sawed from basswood and plywood, this holder provides a convenient place for storing the rubber sink stopper when it is not being used. Fasten holder above the sink in a handy location



This tool punches holes in milk and fruit-juice cans. Use a piece of slim taper file and grind point to a pyramid shape, making all edges keen



Quilt blocks to be cut from silk scraps can be prevented from slipping if each piece is gripped with fine sandpaper cut to form a double pattern

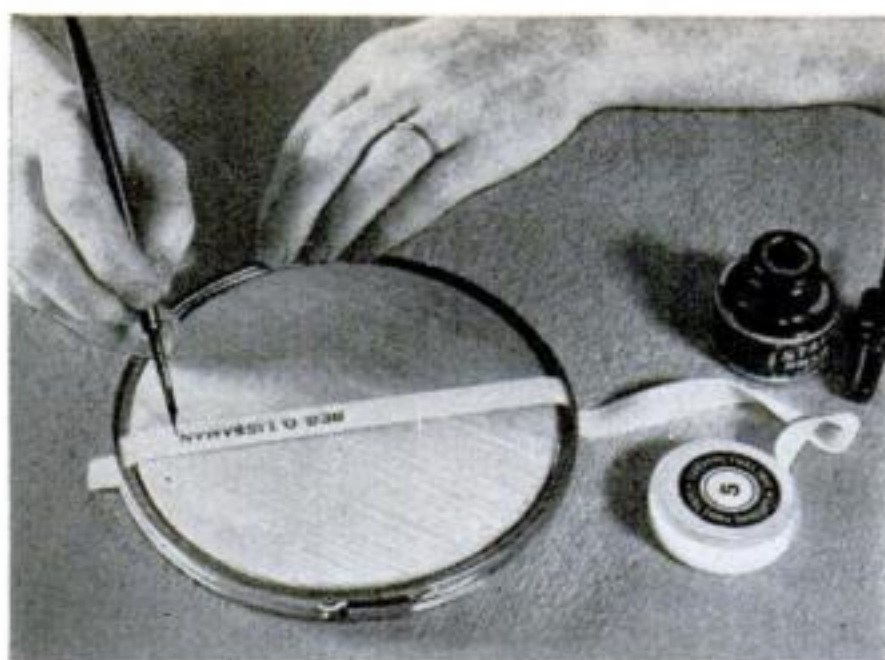
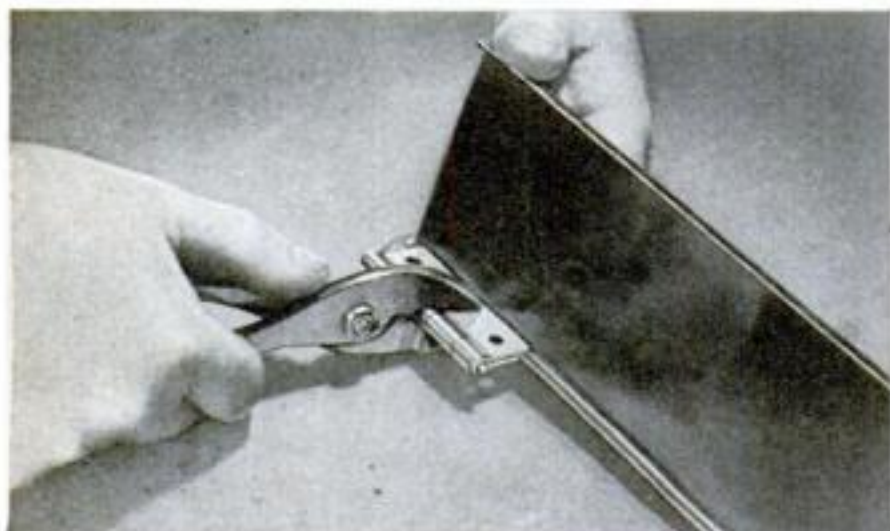
Two-Handled Wire Brush Scours Scaly Paint

AS AN AID in using a wire brush with both hands for scouring paint from buildings, bolt the short leaf from an old auto spring onto the brush, or use a suitable piece of strap iron. Drive screws into the wood at each side of the "handle" as shown below to keep it from turning.



Butt Hinge Helps Bend Sheet-Metal Edges

WITHOUT special tools it is difficult to bend up the edges of sheet metal neatly. Perfect work can be done, however, by using a large butt hinge and a pair of slip-joint pliers as illustrated in the photograph below. The hinge makes possible the bending of sharp corners and prevents marring the piece of metal.

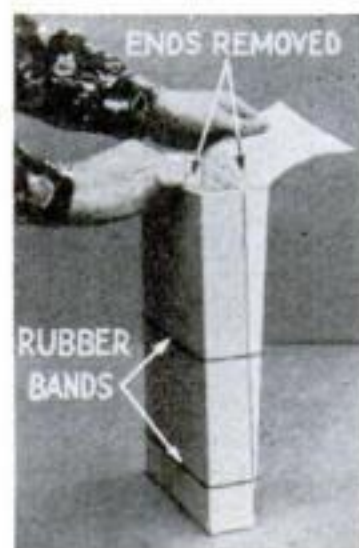


Disk in Hoop Backs Cloth

A WOODEN disk, turned to fit inside an embroidery hoop, is useful to back stretched cloth when designs have to be transferred to it by the hot-iron method or traced by hand. Strips of tape also can easily be held with this device for marking, as shown above. A fairly hard wood is the best kind for this purpose.

Cardboard Box Converted into Temporary File

FOR temporary use a correspondence file can be made from an ordinary two-section cardboard box. Remove an end from both sections, and hold them together with a couple of rubber bands, as illustrated. The file can easily be extended for removing and filing individual letters.



Suction-Cup Door Bumper

TO ATTACH a door bumper for temporary use without marring the woodwork, improvise one as shown above. A rubber suction cup is attached to a small cork by means of the screw, and the cork is forced into a rubber crutch tip. The suction cup will hold the bumper on any smooth surface.

Electrician Finds Many Uses for a Hair Drier

AN INEXPENSIVE household electric hair drier is a useful workshop accessory. For example, in repairing a wiring system after a fire or where damage has been done by leaking water or a flood, the switches, receptacles, and other devices can be removed and dried in a short time. The outlets in the walls and ceilings should be left open about

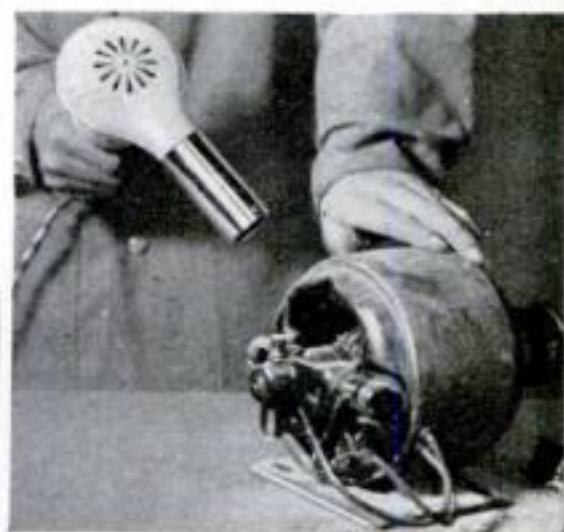
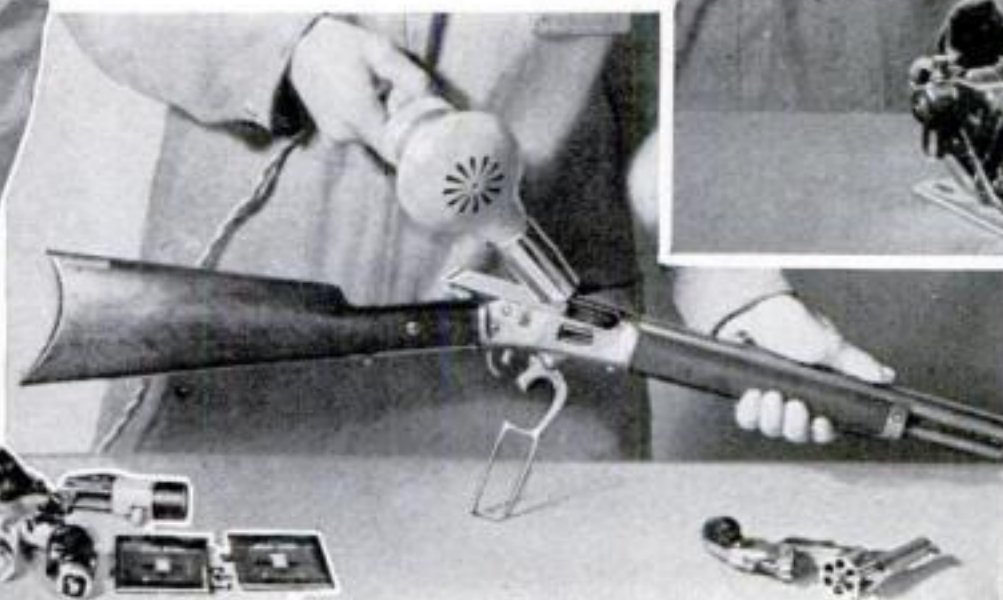
two days to allow all the wires to dry out.

The drier will be found equally useful for blowing off work that is to be painted, drying wet ignition wiring and distributors on cars in the garage, drying firearms that have been exposed to dampness, and drying wet motor control switches in dairies and similar damp places.

The only change made in the drier shown was to remove the original screened end on the nozzle and attach a 3" length of brass tubing with the single screw used with the original end. The tubing seemed to make it more efficient. This may not be necessary for some driers.—HAROLD P. STRAND.



Left, drying wet switches and receptacles. Below, blowing hot air on a gun that was exposed to dampness. At right, removing dust from a workshop motor



DRILL SIZES for WOOD SCREWS

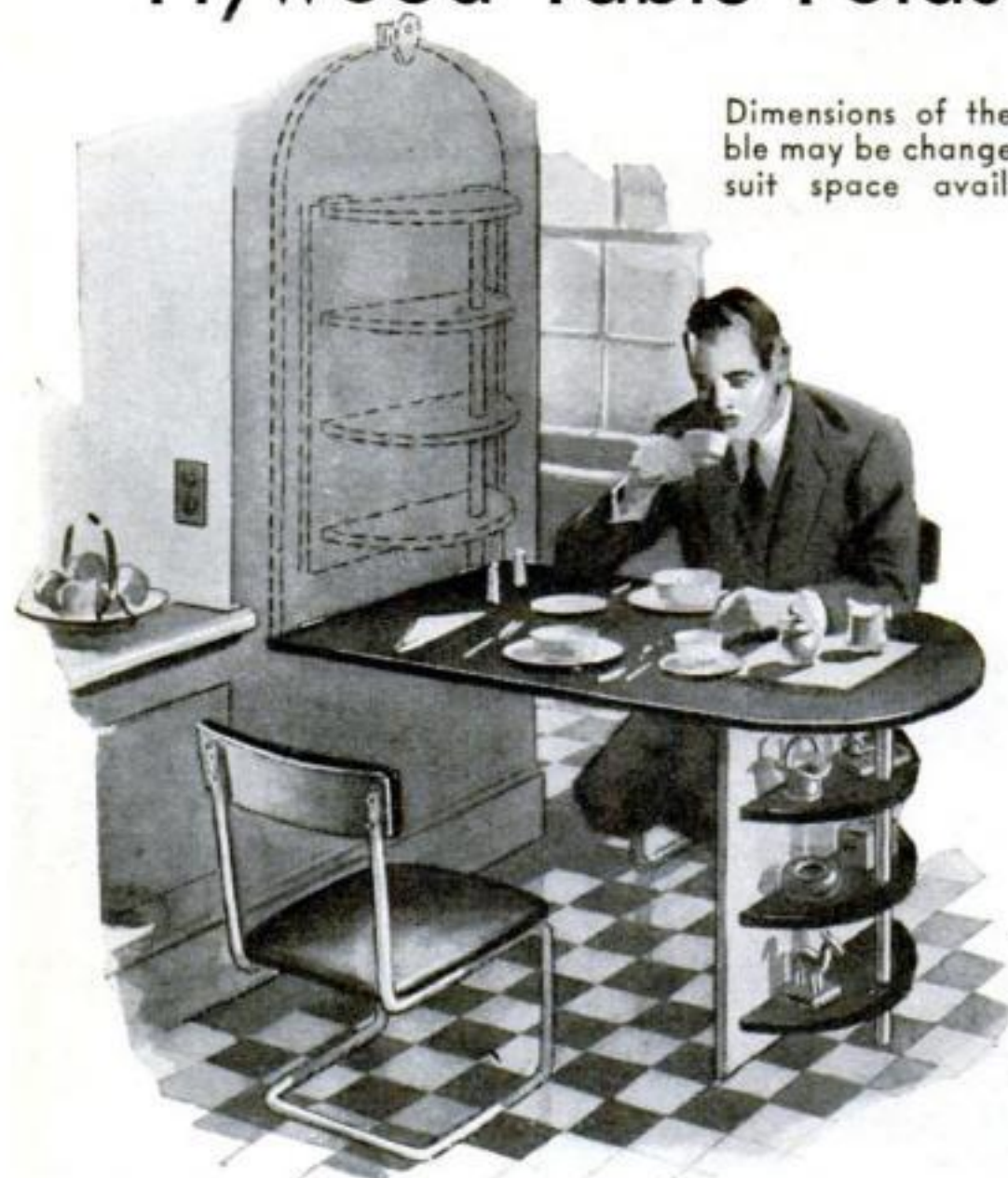
[HARDWARE]

SCREWS		DRILL NUMBERS	
Gauge	Body dia.	For body holes soft wood	For lead holes in hard wood
0	.063	.040	64
1	.078	.045	70
2	.089	.052	68
3	.101	.065	64
4	.116	.077	57
5	.128	.088	55
6	.140	.099	53
7	.149	.106	51
8	.166	.115	49
9	.180	.127	47
10	.191	.133	44
11	.205	.136	42
12	.221	.149	42
14	.234	.158	37
16	.250	.180	E 1/4"
18	.282	.205	K 9/32"
20	.312	.215	O 5/16"
24	.375	.260	R 11/32"
			V 13/32"
			14 A 15/64"

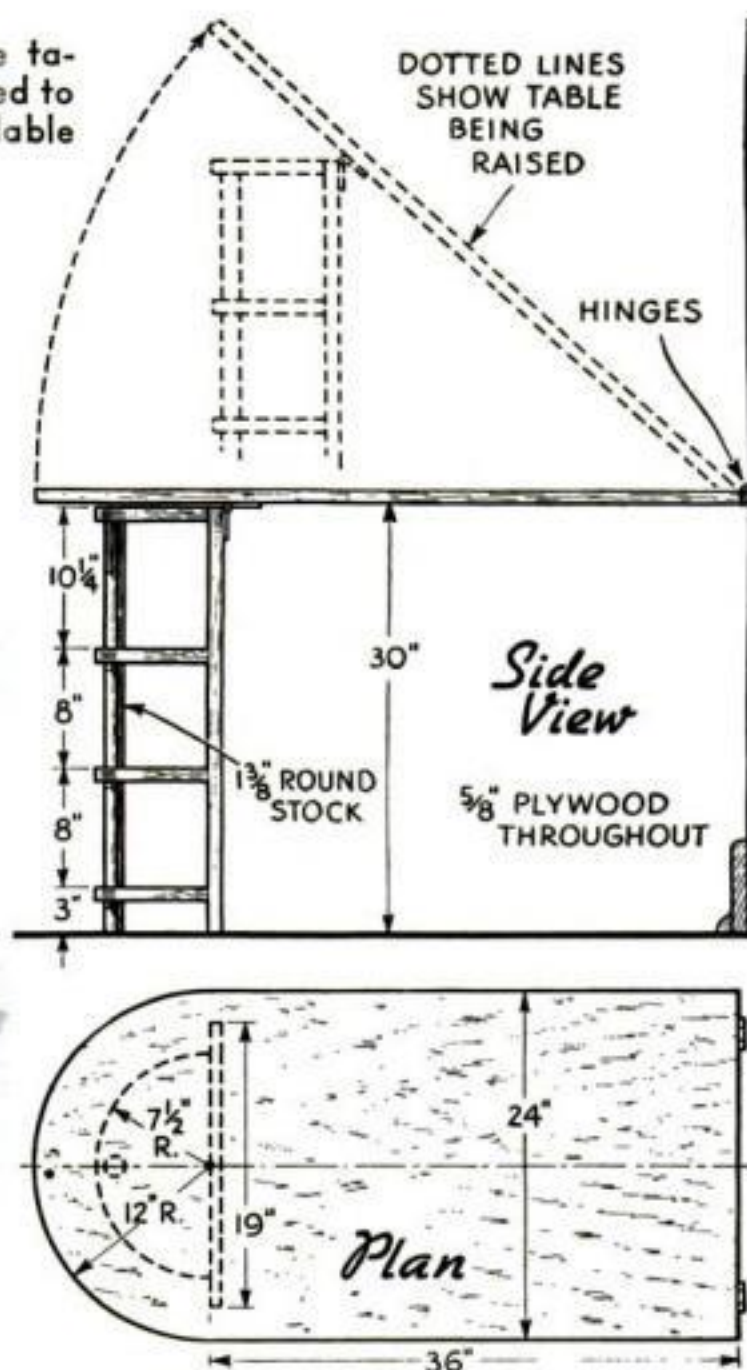
Note: Body holes are a loose fit for the screws. Lead holes are 70 percent of the root or core diameter for soft wood, and 90 percent for hard wood.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Plywood Table Folds Against Wall



Dimensions of the table may be changed to suit space available

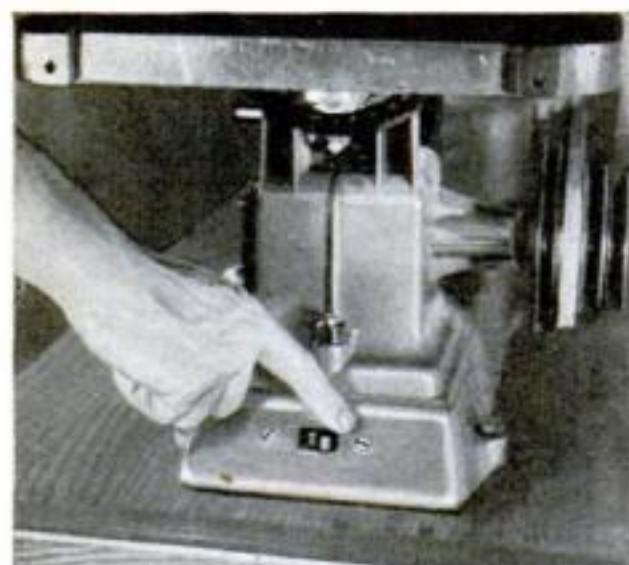


AN UNOCCUPIED space on the kitchen wall can be put to good use by installing a modern folding breakfast table. Plywood $\frac{5}{8}$ " thick is an excellent material to use. It is assembled with screws and casein glue. The shelves could be of thinner stock, but it is somewhat simpler to use one thickness throughout. The four pairs of butt hinges are recessed. A wood latch holds the

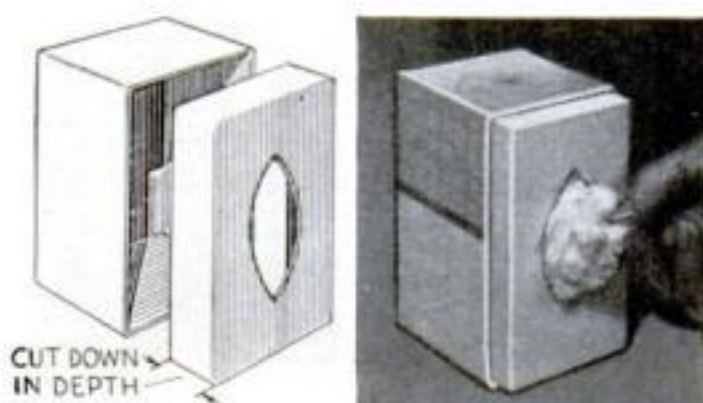
table against wall when not in use. For decorating the shelves, pick out ornaments, as far as possible, that can be screwed or cemented in place.

Convenient Scroll-Saw Switch Mounted Inside the Base

A SWITCH mounted inside the base of a scroll saw gives convenient control of the machine. Drill a hole for the toggle of the switch and file to the required size. Attach the switch inside the base with small, flathead machine screws of suitable size.—W. T. B.



• • •
TO PREVENT framed pictures from tilting to one side of the other, glue a strip of sandpaper along the back of the frame at the bottom. Friction keeps the frame horizontal.



Telescoping Dispenser Keeps Cotton Handy

THIS dispenser keeps a supply of cotton always within easy reach of the finger tips. It is made from a deep cardboard box, the inner section of which is cut down to half the depth of the outer one so that it can telescope in and out. An opening is then cut in it as shown above.

Wooden Legs Keep a Baby Carriage from Tipping Over

TWO wooden T's used as illustrated will prevent a baby carriage from tipping over, no matter how much a baby bounces around in it. This may prevent an accident because modern baby carriages are often made with a very short wheel base so that it will be easier to maneuver them in and out of small homes and apartments, and around the furniture in the rooms.

The horizontal part of each T has tapered ends so they can be inserted into the straps on which the body of the carriage is suspended. The vertical part is about 2" longer than a plumb line from straps to floor, and it is kept from slipping by a long hook or stiff wire, which connects it with the axle.—BERTRAM BROWNOLD.



Braced as at the left and below, the carriage cannot tip when the baby moves about



A belt checks the baby from tumbling out

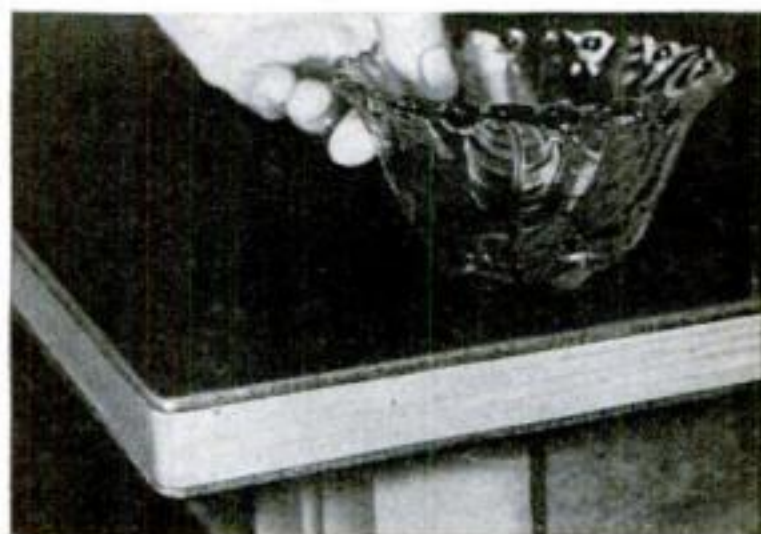
Elbow Strap Helps Carry Big Basket

CARRYING a heavy basket of corn or other feed on the farm is a back-straining task when the basket is carried by its two handles in the normal way. If a person is reasonably muscular, it is much easier and more convenient to carry the basket by one arm with the aid of an arm strap with a hook, as shown.



Wear-Resisting Tops for Kitchen Tables

RIGID, smooth, wear-resisting tops for kitchen tables can be made by gluing $\frac{1}{8}$ " pressed composition board to both sides of a 1" thick core of poplar or other wood that does not warp readily. Use tempered-quality board of a color to match the surroundings. Fasten the rougher side to the core with a good grade of glue. As a rule you can have the work done at a lumber or sash-and-door mill if no large press is available. The table top shown below was finished by staining the poplar core edges a light yellow with thinned lacquer, and then applying two coats of floor wax to the top and edges. The same type of construction can be used for making sturdy doors.



Feed Crock Lures Rats to Death

RATS can be exterminated easily by the following method: In a 10-gal. jar, put some feed of various kinds, cover with a thin layer of oats, and place where the rats have access to it. Replenish the feed for several days to get them accustomed to coming to the jar for food. Then remove everything from the jar, fill it half full of water, and sprinkle an inch or two of oats on top. Since the oats float and look the same as usual, the rats will jump into the jar and quickly drown.

Private Phone

By KENDALL FORD

WITH this easily built telephone set, you can talk to a person in another room or in some near-by house at almost negligible cost. The only operating expense will be the occasional renewal of the dry cells.

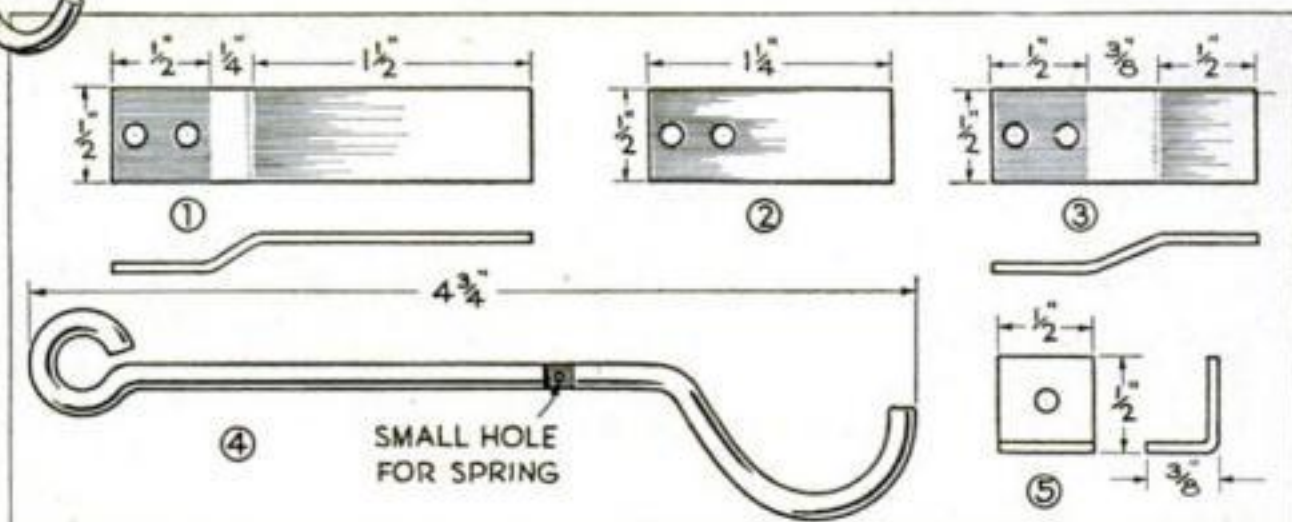
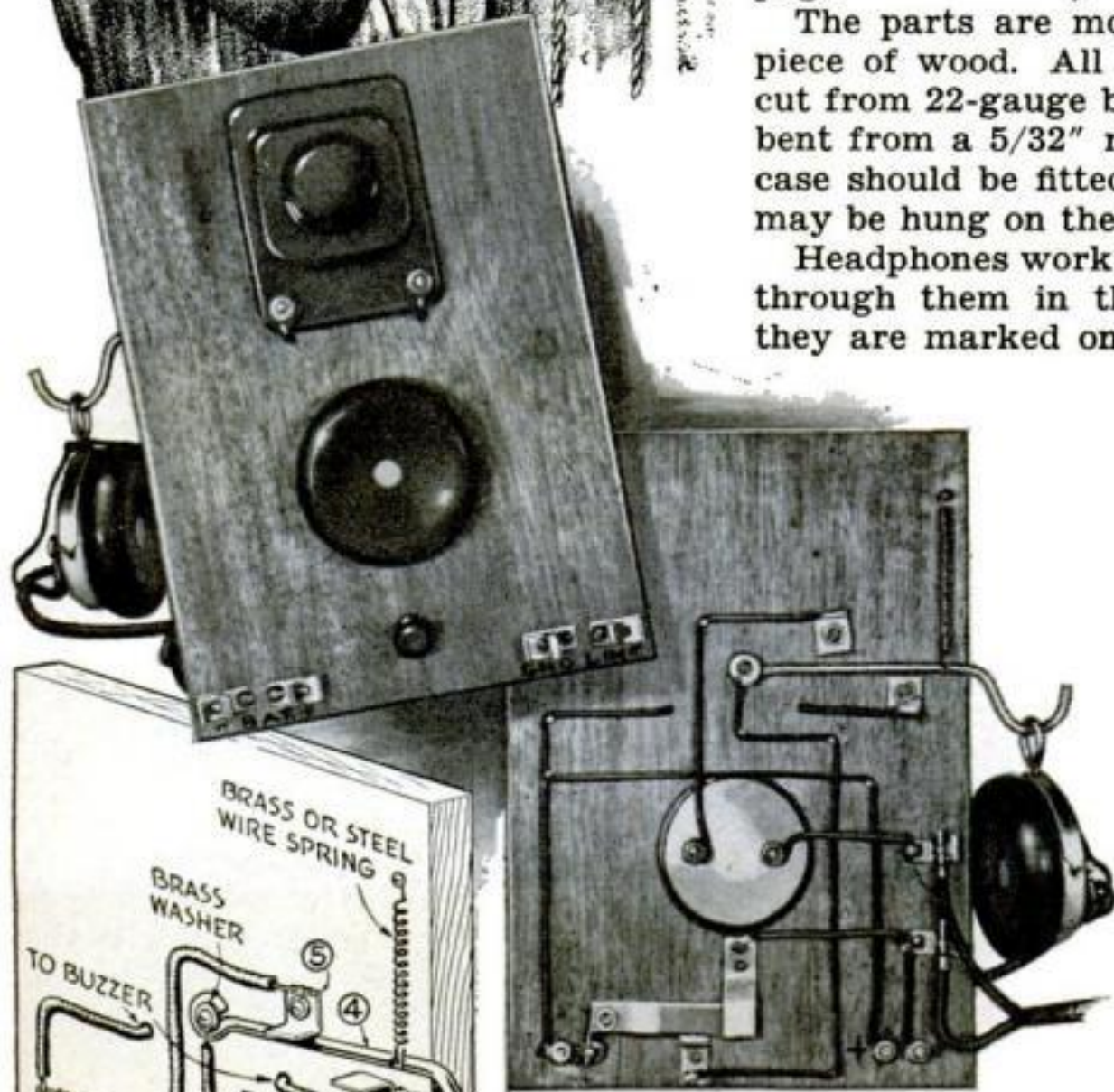
The main items needed for each unit are an electric buzzer and a pair of old radio headphones. If you do not own headphones, a secondhand pair may be purchased cheaply at salvage stores. Phones that have lost their magnetism and are no longer sufficiently sensitive can be restored by the method described at the top of the following page.

The parts are mounted on a $\frac{1}{2}$ " by 6" by 9" piece of wood. All of the flat metal fittings are cut from 22-gauge brass, and the receiver hook is bent from a $\frac{5}{32}$ " round brass rod. The receiver case should be fitted with a small ring so that it may be hung on the hook.

Headphones work better when the current flows through them in the proper direction. Usually they are marked on the back of the case with a

+ sign to indicate the particular terminal that should receive current from the positive terminal of the battery. If your headphones are not so marked, try connecting them both ways to find which gives better results.

Where a good water-pipe ground connection is available, only one line wire will be required. If no ground connection can be used, it will be necessary to run two wires between the stations. Fence



Line Costs Little to Rig Up

REMAGNETIZING PHONES

[ELECTRICAL]



Old radio headphones and similar telephones sometimes become demagnetized and lose their sensitivity. Remove the composition cap and see if there is sufficient magnetism to hold the metal diaphragm. If not, the magnet may be recharged by making a small electromagnet as shown. The dimensions are not important, but the ends should be the same size and distance apart as the headphone magnets. Connect the electromagnet to a dry cell and use a magnetic compass to determine the polarity at its ends. Find the polarity of the headphone magnet in the same way. Place the electromagnet against the headphone magnet so that opposite poles will be together for about one minute.

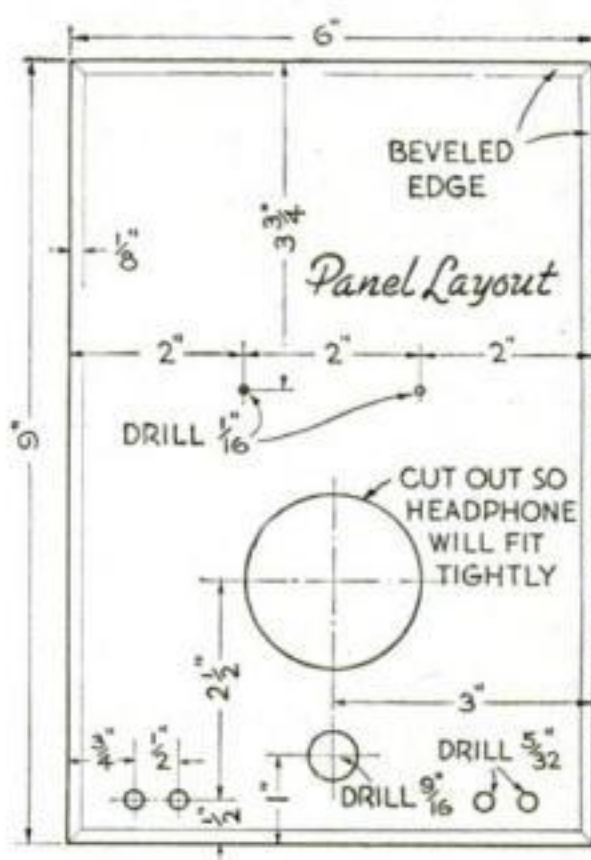
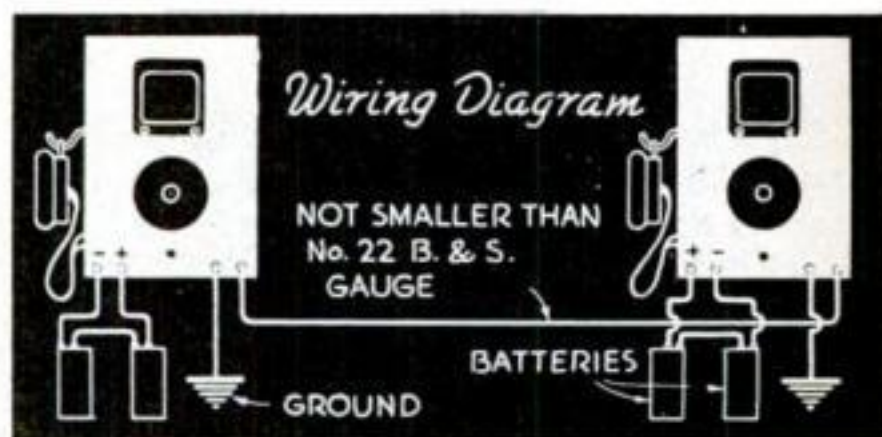
POPULAR SCIENCE MONTHLY SHOP DATA FILE

wires may be used if there is no metal connection between them.

In the wiring diagram it should be noted that the dry cells at each telephone are so connected that similar terminals on the telephone are connected to opposite poles of the dry cells. This permits all of the dry cells to be in series when the receivers are off their hooks. The number of dry cells required for the circuit will depend upon the adjustment of the buzzer and the distance between stations. For short distances, one cell at each end is sufficient.

When the receivers are in place on their hooks, pressing the push button will cause the buzzer at the opposite end to buzz. As soon as the receiver hook is raised, the buzzer circuit is automatically disconnected.

If the telephone set is to be mounted on a wall, it should be kept at least $\frac{1}{2}$ " from the surface so that the moving parts will have sufficient clearance.





Bullet-Type Bed Lamp Useful in the Shop

A CHEAP and excellent substitute for a special tool lamp is one of the bullet-type bed lamps now in common use. This lamp is equipped with a clamp and a swivel joint by which it may be directed at practically any angle. It is not, of course, as compact a lamp as the special ones sold for the purpose, but the cost is only about half as much.—T. G. HETRICK.

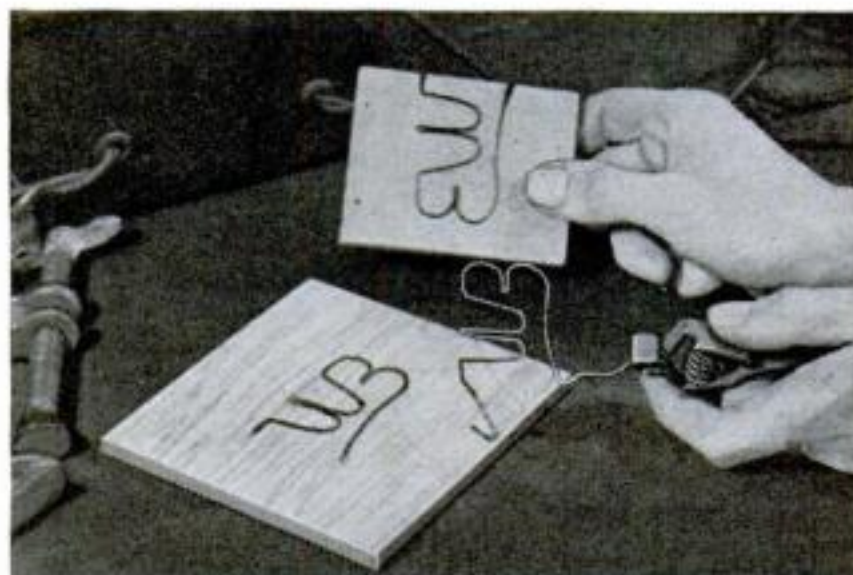
• • •

WHEN the tip of a soldering iron becomes dirty, simply heat the iron, insert the tip into a wad of steel wool, and twist it around and around.—HAROLD R. KUNTZ.

Electric Branding Iron Marks Wood Indelibly

YOU can burn your monogram or other design in wood, fiber board, and the like, with a piece of iron wire bent as illustrated. Lay the wire in position, place over it a wooden block, and apply C-clamps or weights. Connect the projecting ends of the wire to a source of electric current, preferably a low-voltage supply such as a storage battery or a soldering or welding transformer. You can, however, use a standard 115-volt source if you place sufficient resistance in the circuit to keep the current within safe limits.

Leave the power on until you see smoke emerging from beneath the hold-down block. Five seconds should be enough, although you may have to experiment a little with wire length and diameter.



Monogram branded in wood with a die of iron wire heated by the soldering transformer in background

LEAD-COVERED WIRES IN CONDUIT

[ELECTRICAL]

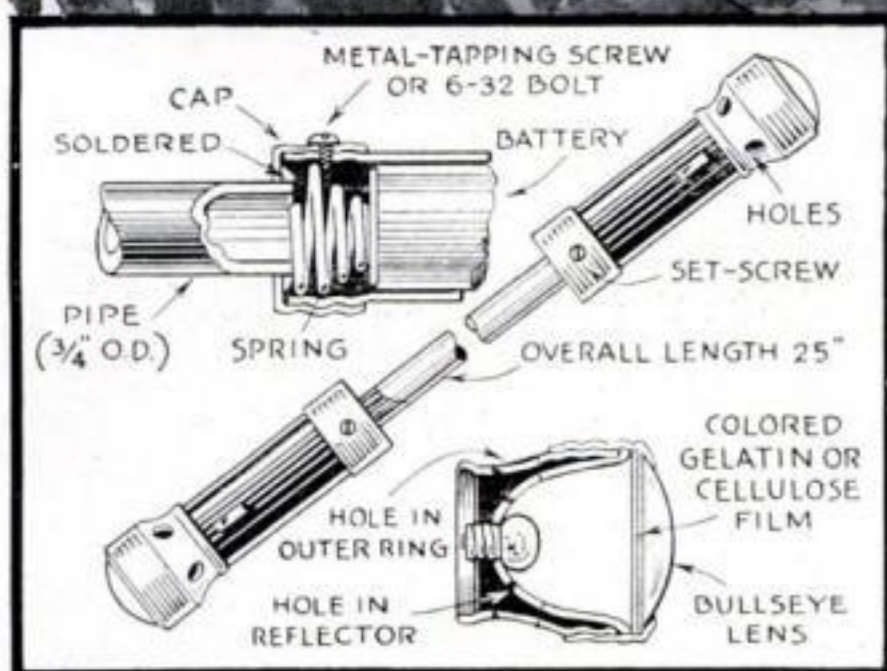
Wiring run underground, as between the house and garage, is usually installed in rigid conduit, and the wires should be lead covered. As this type of wire is larger than ordinary rubber-covered wire, a special table is needed to show the size of conduit in relation to the number of wires. If smaller conduit is used than called for in the table, the lead covering may be damaged.

Size of conductor	One-wire				Two-wire				Three-wire			
	1	2	3	4	1	2	3	4	1	2	3	4
14	1/2"	3/4"	3/4"	1"	1/2"	1"	1"	1 1/4"	3/4"	1 1/4"	1 1/2"	1 1/2"
12	1/2	3/4	3/4	1	3/4	1	1 1/4	1 1/4	1	1 1/4	1 1/2	2
10	1/2	3/4	1	1	3/4	1 1/4	1 1/4	1 1/2	1	1 1/2	2	2
8	1/2	1	1 1/4	1 1/2	1	1 1/4	1 1/2	2	1	2	2	2 1/2

These specifications refer to straight conduit runs or those with nominal offsets equivalent to not more than two quarter bends.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

ILLUMINATING Band Uniforms and Batons



atin or cellulose film disks are placed behind the lens which, preferably, should be of the bullseye variety so that it will be visible from the side. Set screws prevent the cases from unscrewing out of the caps as the baton is whirled. The twirling of the baton presents a beautiful pattern in the dark.

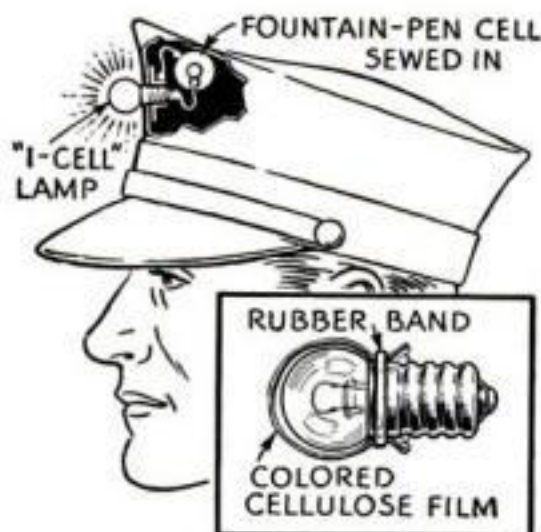
The Willoughby band also uses colored electric lamps installed on the shoulders, chest, and caps of the players' uniforms. Flash-light lamps, colored filters for them, small flexible wires, and the necessary battery cells are the only equipment required.

The method of illuminating a bandsman's cap is shown in detail. The lamp is turned on or off by screwing it in or out, and it should therefore fit the socket tightly enough to prevent its loss when partly unscrewed.

AT NIGHT performances, the Willoughby, Ohio, High School band arouses much favorable comment by the spectacular use of illuminated batons and uniforms. Stadium or auditorium lights are turned out, and the band-uniform lamps and illuminated batons instantly turned on. The light display, with the music, provides an impressive spectacle. Miniature electric lamps and batteries of the flash-light type make the stunt possible, and any band can duplicate the effect without difficulty.

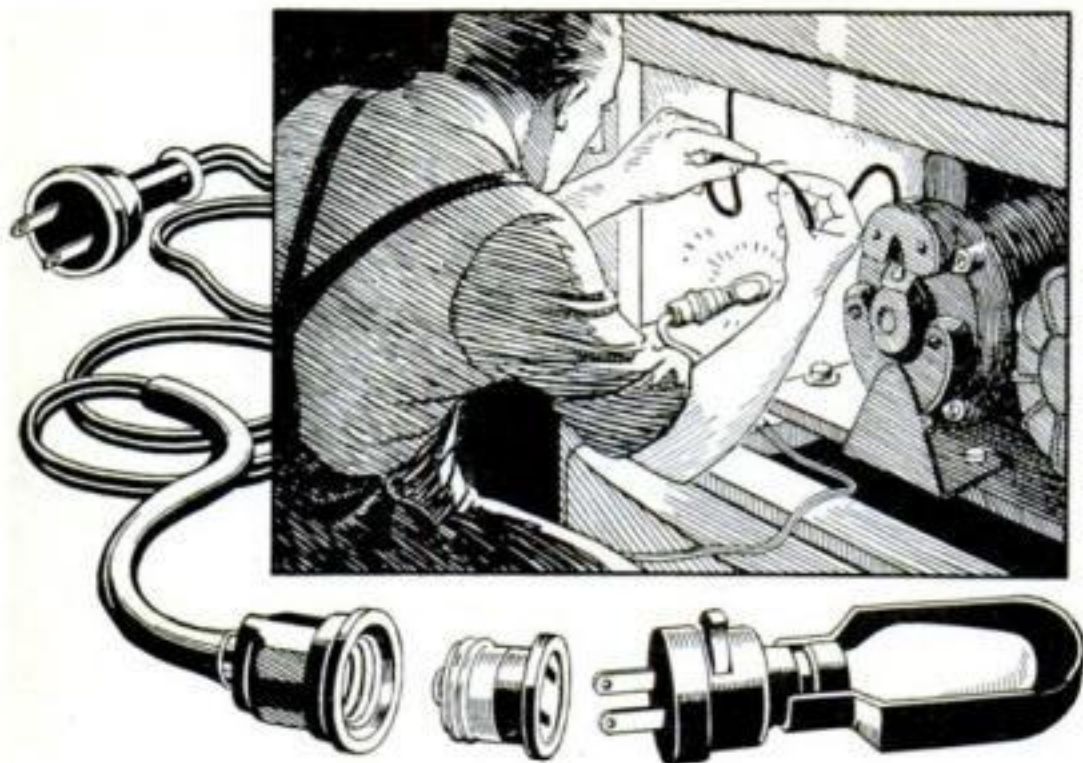
The construction of an illuminated baton similar to that used by the band is shown. On the ends of a length of nickel or chrome-plated pipe measuring about $\frac{3}{4}$ " in outside diameter are mounted metal-cased, two-cell flash lights. These use the 1" diameter "baby" type battery cell.

Several small holes are cut in the front ring and reflector of each flash light to let rays from the lamp pass out through the sides. Colored gel-



Method of mounting lamp in a bandsman's cap. The bulb must fit the socket tightly

Uniform lights are similarly arranged, but should include a switch. A flash light minus its lens is carried in a pocket. It is fitted with a plug which can be screwed into the lamp socket, and wires run from this plug to lamps mounted on shoulders and chest or other parts of the uniform. So-called "Litz wire" is excellent because it is small and highly flexible. This wire was formerly much used for installing loop radio aerials.—WALTER E. BURTON.



Small Trouble Lamp for Confined Work

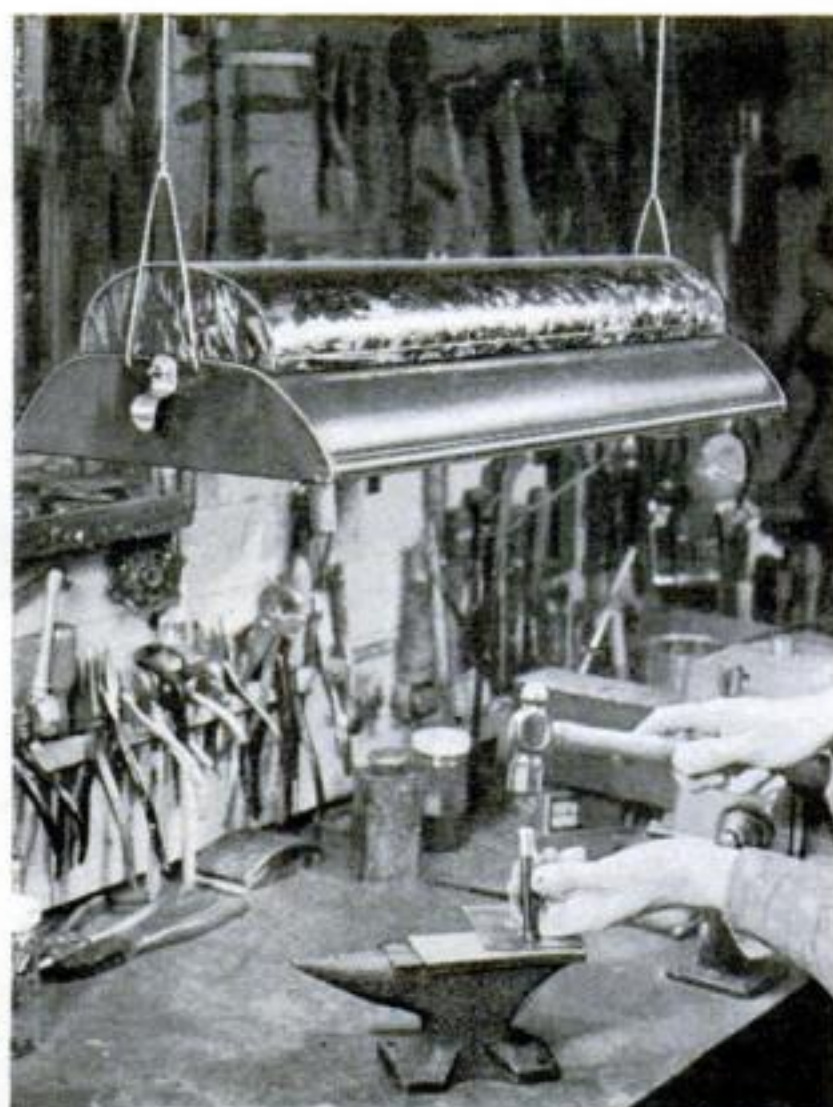
WHEN splicing wires in confined spaces, the average trouble lamp gives excessive light and heat. A small night-light bulb with guard and switch attached is better for most work of this kind. A soft rubber plug and a weatherproof socket are used. The connections where the cord is spliced to the leads of the weatherproof socket and enters its plug should be protected with rubber tape, and this in turn covered with rubber hose.—RAY BLAIN.

Eaves-Trough Fixture Holds New Tubular Lamps

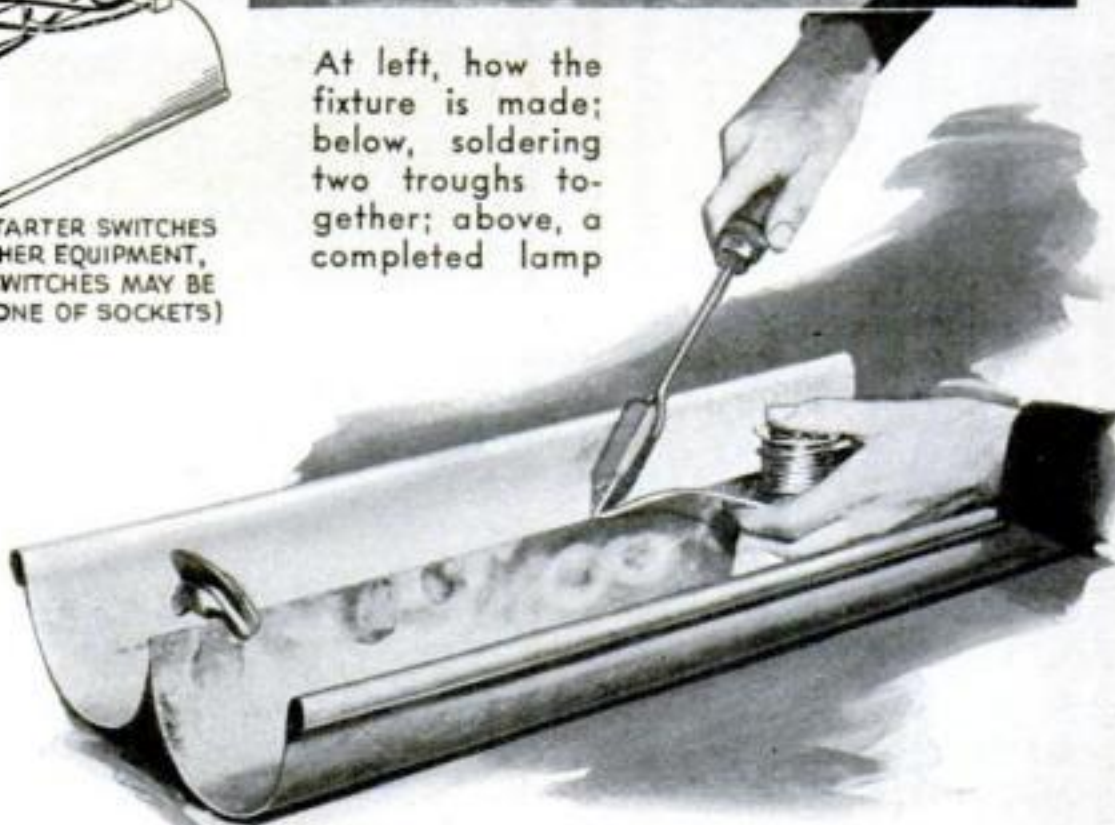
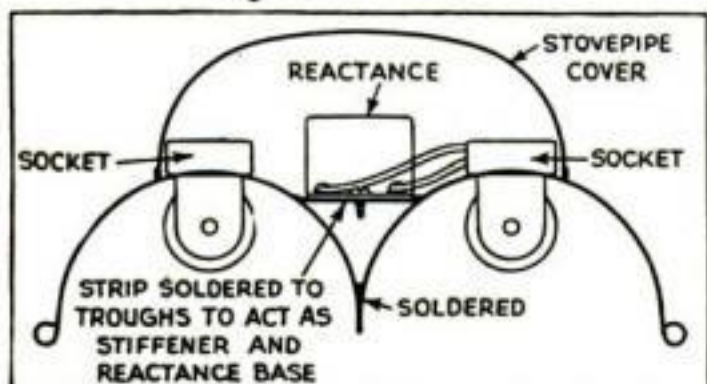
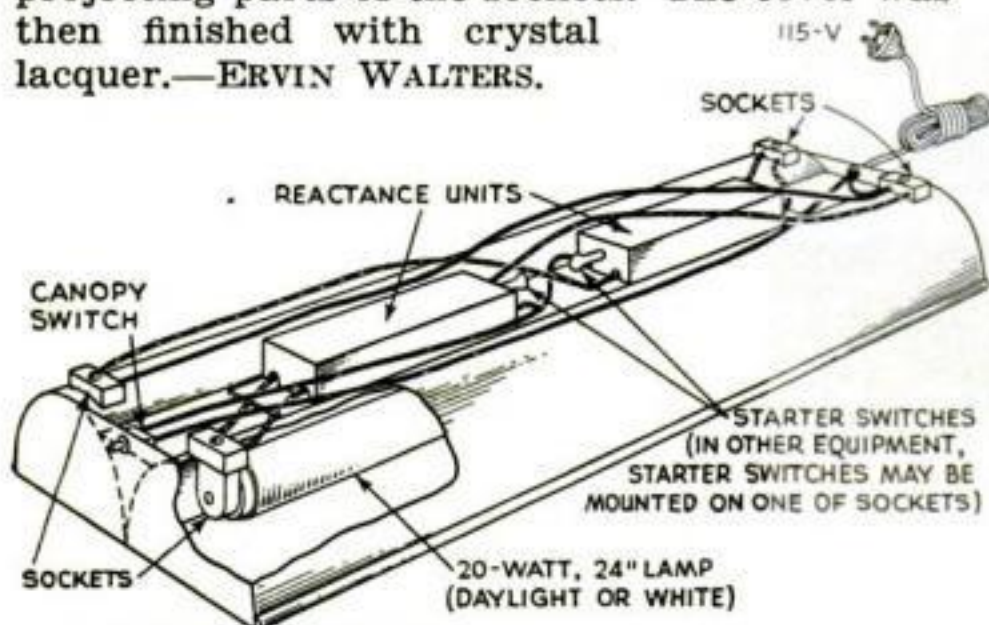
EXCELLENT reflectors for tubular fluorescent lamps can be made from ordinary galvanized-iron eaves trough. The photographs show a lighting unit for two 24" long, 20-watt lamps. Two 25" lengths of 5" trough were soldered together along the unrolled edges, and end caps were soldered in place. A stiffening strip 2" wide was soldered between the troughs, and it also acts as a base for the reactance units.

Rectangular holes were cut for the lamp sockets, and the reactance units were fastened to the stiffening strip with self-tapping screws. The inside surface of the troughs were given a coat of aluminum paint, followed by two coats of white casein paint. On the outside, the reflector unit was finished with lacquer.

A length of 3" stovepipe was separated at the seam, spread apart, and provided with soldered-on ends so as to form a cover for the reactances and wiring. It slips down around the projecting parts of the sockets. The cover was then finished with crystal lacquer.—ERVIN WALTERS.



At left, how the fixture is made; below, soldering two troughs together; above, a completed lamp





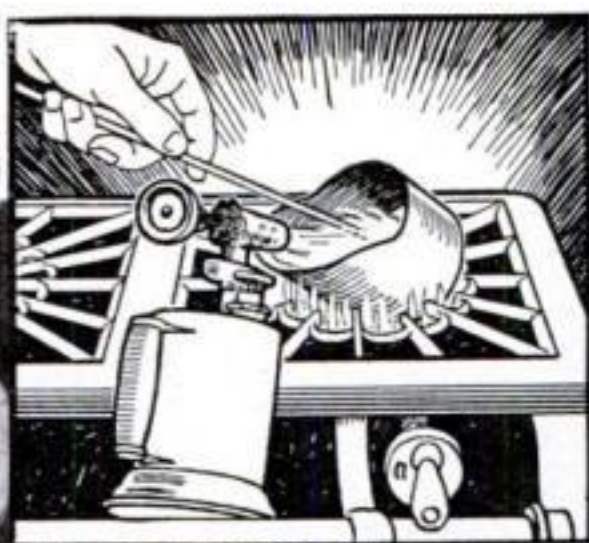
NEW SHOP IDEAS

GAS PLATE AND BLOWTORCH

Melt Aluminum Scraps



Rough castings and, upper left, turned sunshade and filter rings



Pouring the aluminum from the tin-can crucible into a tin-can mold. Above, how the heat is applied

ALUMINUM scraps can be melted and cast into usable shapes quickly and economically with the combined heat of a laundry gas plate or other gas stove and an ordinary gasoline blowtorch. The crucibles are discarded tin cans, which are cut as shown with the vertical seam to the rear so they are about 2½" high in the back and from 3" to 4" high in front. The can is set over the burning gas jet on an angle so the high side faces to the front.

The lighted blowtorch is set against the gas plate frame, and in the majority of cases will stay there without being held. The flame of the torch is directed to the inside of the tin can and aimed at one side so that it will swirl over the aluminum. Small bits of aluminum scraps are added, and the heat melts them very quickly.

Round aluminum stock for turning may be cast in discarded tins in various shapes and forms. It is advisable to direct the flame of the torch on these tins a short time prior to pouring the molten metal.

Oxidation will occur unless the molten metal is stirred constantly, but it does no great harm as pure metal will pour from the bottom of crucible, leaving the oxidized metal in the crucible. One necessary warning is to use only pure aluminum in the tins as various other similar metals cause

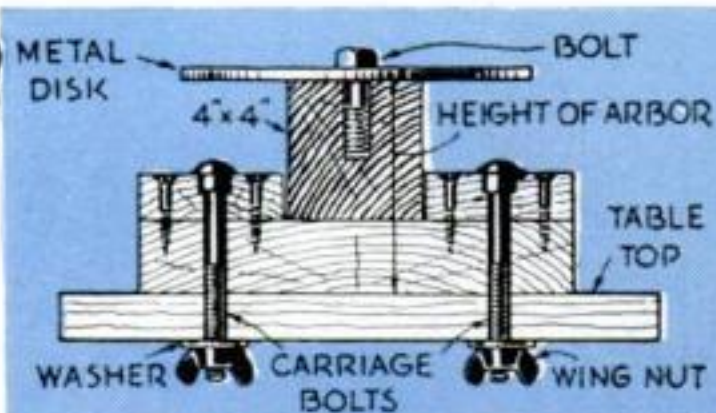
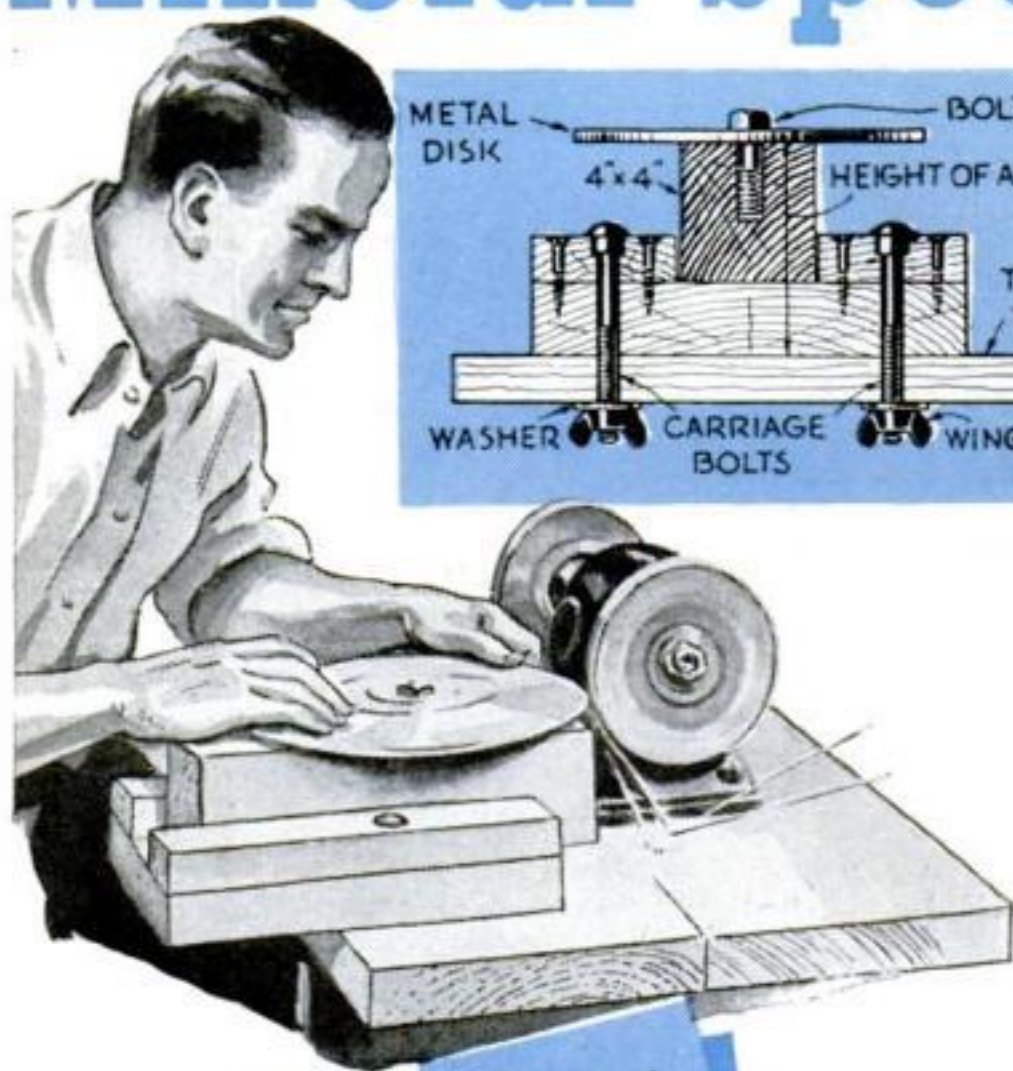
the tin itself to melt. A cast-iron crucible can be used successfully if available, but will take longer to heat.

Castings used in turning parts for small motors, camera fittings, and the like, have been made by this method up to 4" diameter and 4" high, and plates up to 1" thick and 5" square.—CHARLES H. GOTTWALT.

Bronze-Welding Broken Gears

WHEN a broken gear tooth has to be built up by bronze-welding, chip off what is left of the tooth and undercut the gear rim about ⅛". If two or more adjacent teeth are involved, follow the same rule, but also remove one third of both connecting sound teeth so as to strengthen the patch and ease the milling operation.—H. J. C.

Mineral Specimen Saw



By **W. T. BAXTER**

Instructor of Jewelry and Gem Cutting,
Woodrow Wilson High School,
Washington, D. C.

ROCKS and mineral specimens can be sectioned on this easily built saw into slabs of any desired thickness for exhibition, scientific purposes, or for grinding into semi-precious gem-stone cabochons.

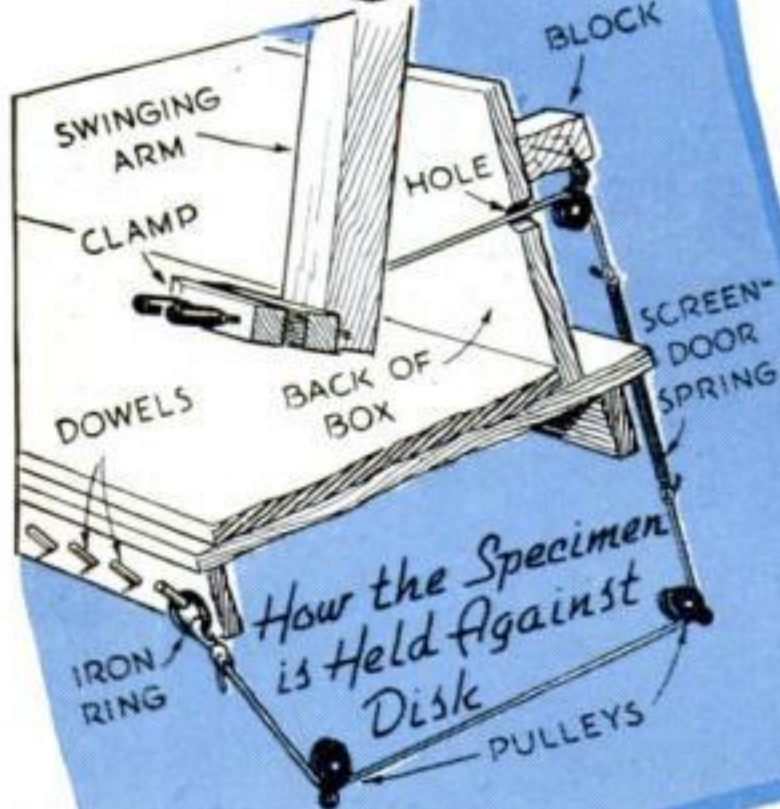
The saw can either be a diamond-charged disk (P.S.M., April, '38, p. 90) running in kerosene and lubricating oil, or a plain steel disk running in a mixture of silicon-carbide grit, No. 100 mesh, and water to which a little fine clay flour has been added. If silicon-carbide grit is used, be sure all bearings are protected.

A disk 10" or 12" in diameter is satisfactory for most purposes. Galvanized iron, 22 or 24 gauge, may be used for the grit saw, but a hard steel disk of 20 or 22 gauge

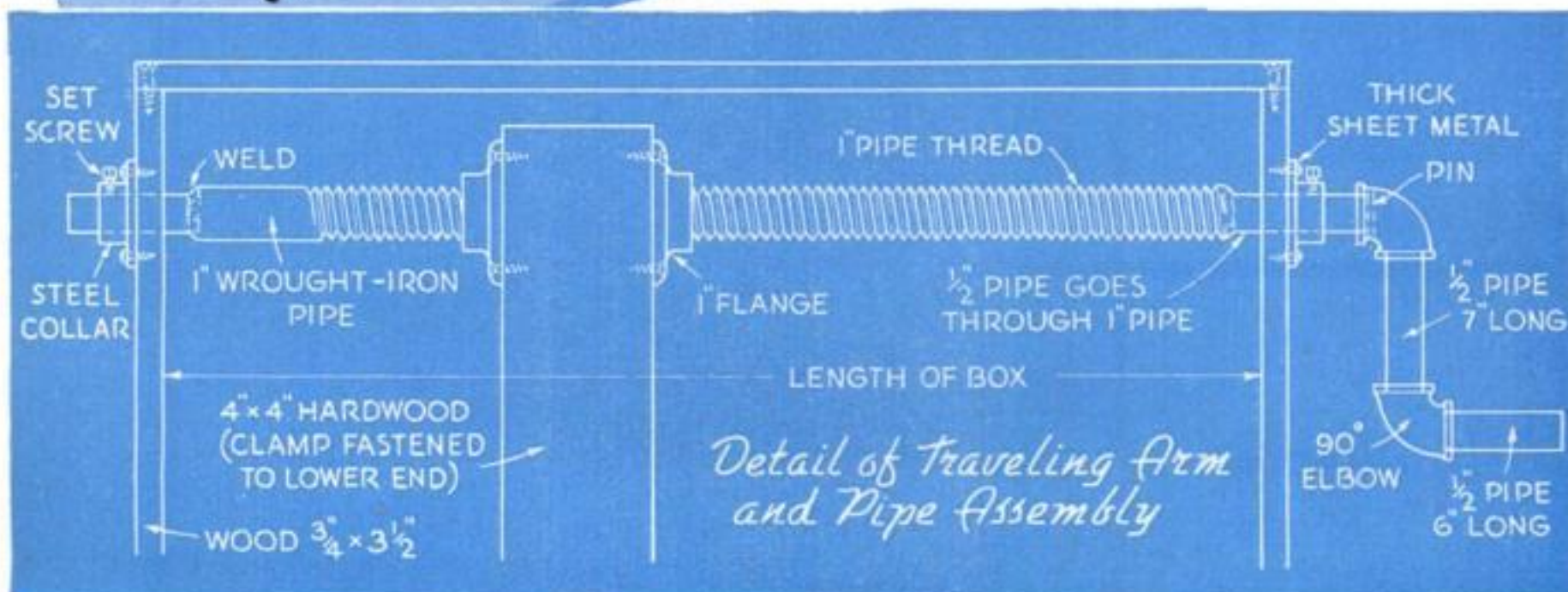
(B.&S.) is required for making the diamond saw.

Reduce the speed of the arbor to around 400 r.p.m. Where a bench-type buffer-grinder head or a so-called "saw mandrel" is used, a countershaft will do this. If the arbor is mounted directly on the side of the box, use a large pulley. Both methods are illustrated.

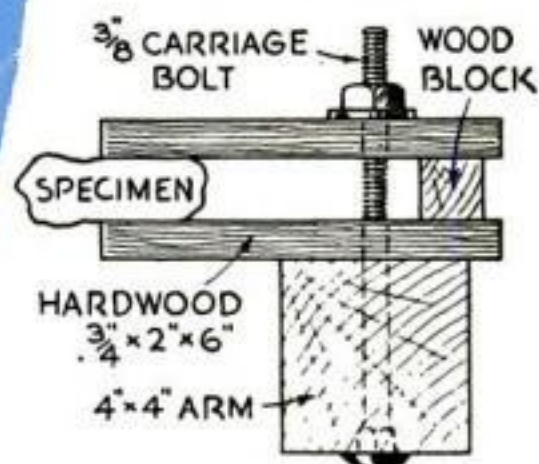
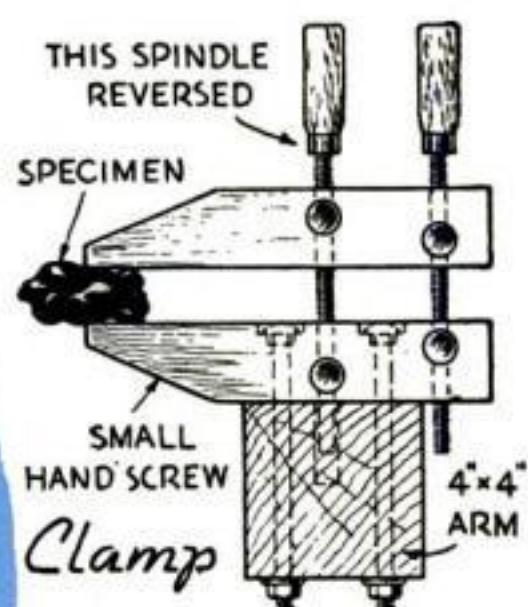
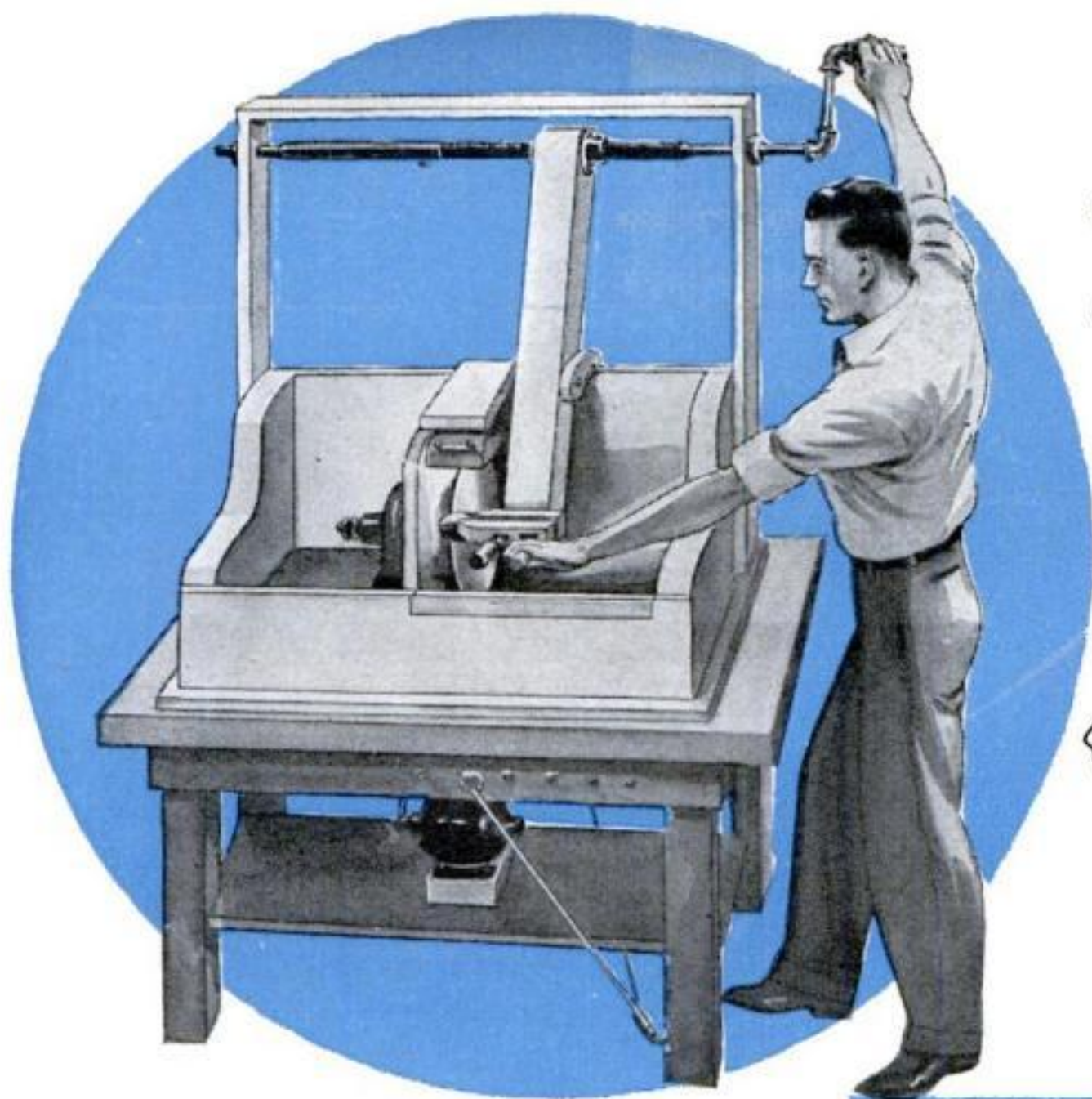
Any size box can be used, but one from 24" to 36" in length and about 24" wide is



Above, truing a disk. Left, how tension is applied



The thickness regulator at top. Pipe and fittings cost 75 cents, threading \$1, and welding 75 cents

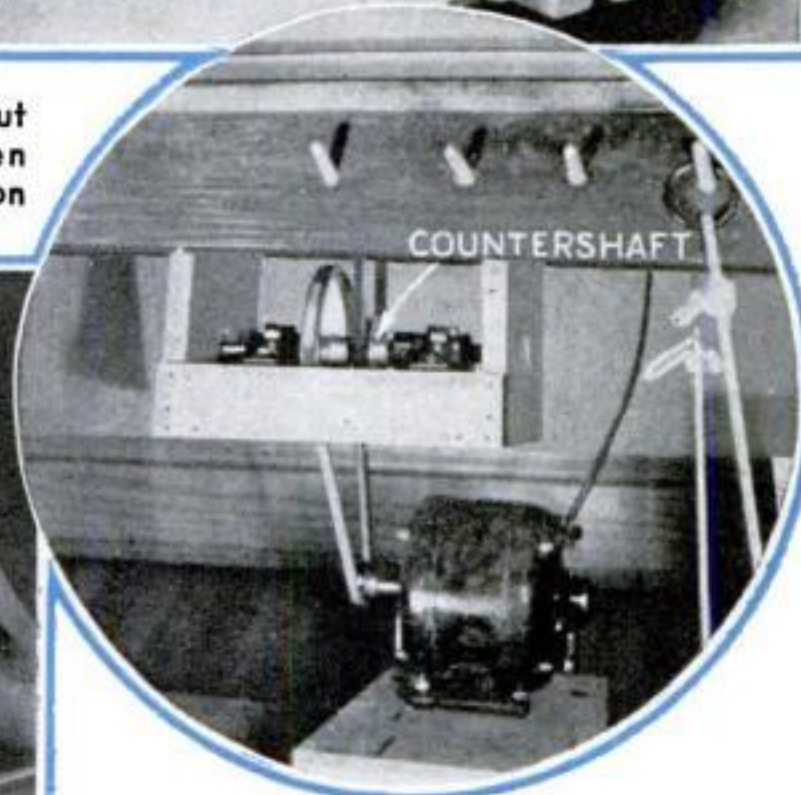
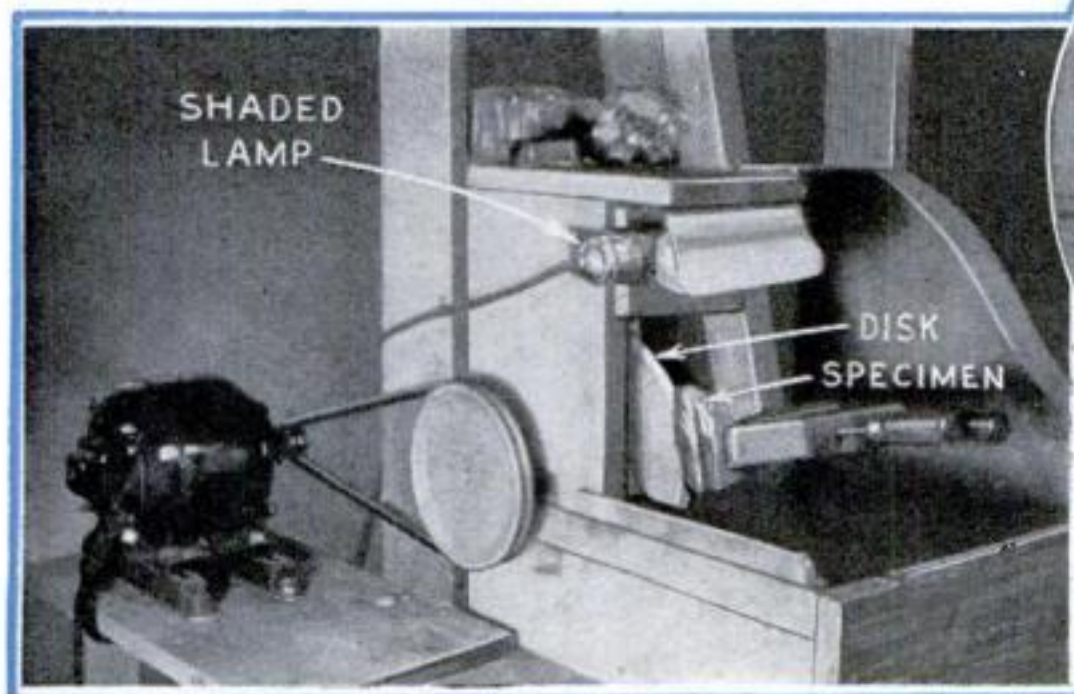
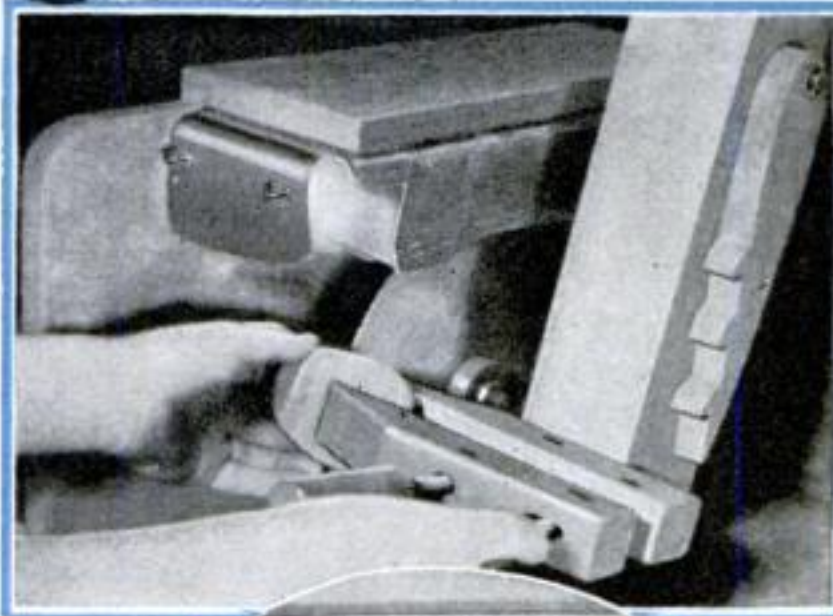


Alternate Method of Holding Specimen

usually large enough. Mount the box on a suitable table. Build a well into the box underneath the disk for the abrasive or oil. If grit is to be used, line the box with galvanized iron or preferably copper. Tin is a suitable lining for the diamond saw because oil is used. Shield the top of the box directly over the disk to avoid splashing. A light built into the box to illuminate the saw is handy.

In making the pipe assembly for the top, have the large pipe welded onto the small pipe. The weld should be ground down below the level of the large pipe. The right-hand end of the large pipe

At right above, cut groove in specimen before applying tension



Above, countershaft mounted under table. Left, machine with arbor on side of box

must, of course, be threaded to fit the flanges.

Tension is applied to the arm to hold the specimens against the blade by means of a screen-door spring, small rope, and pulleys. Hold the specimen against the blade until a shallow groove is formed before applying tension. Note the wooden ratchet for holding the arm forward while clamping or traversing the specimen.

When the saw is in operation, a cloth is hung in front to prevent splashing. Two hooks for this purpose are soldered on the front of the shade over the lamp. They can be seen in the photo which shows the first

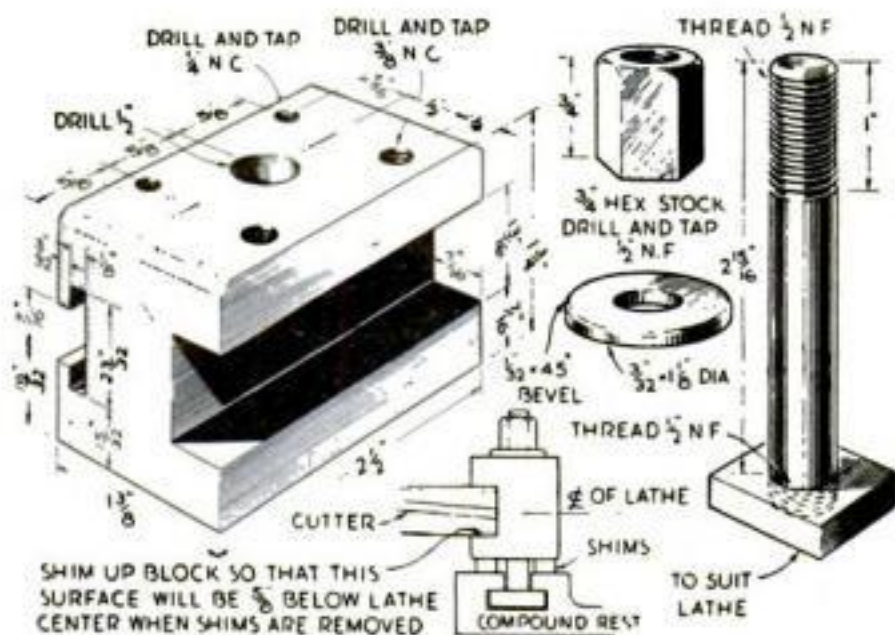
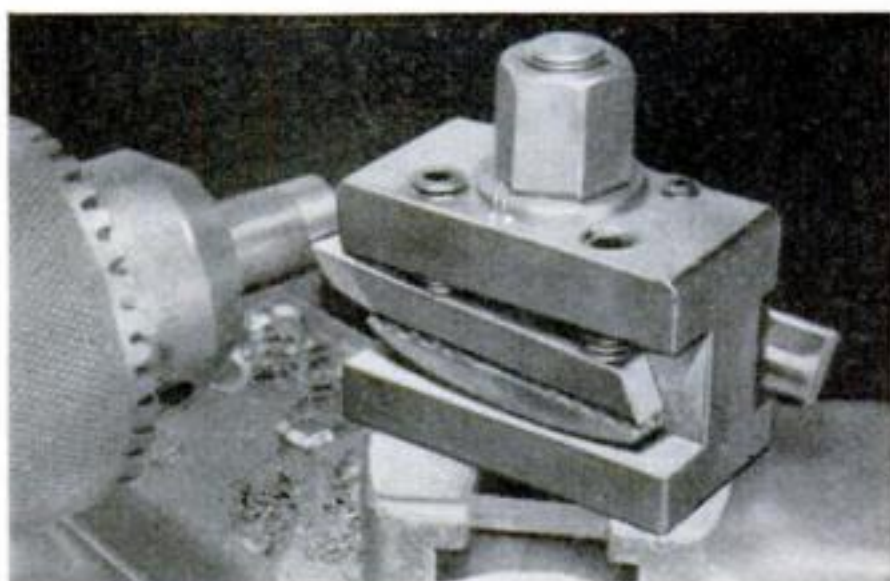
step in starting to cut a specimen. The saw cuts from the top toward the bottom of the specimen.

The sawing disk must be true. A quick method of truing a bumpy disk is shown at the beginning of the article. The saw pivots on a bolt dropped through the arbor hole into a hole in a 4" by 4" sliding block, and the block is pushed forward until the blade touches an abrasive wheel. If the sliding block wears or fits too loosely, soak it in water a few minutes before using. A wet sponge held on the disk near point of cutting will prevent burning.

Slotted Lathe Tool Post Stays in Adjustment

ONE advantage of the lathe tool post illustrated is that it holds the cutter bits at the proper height, and when the position of the tool is changed, the height does not have to be readjusted. In addition, it eliminates the necessity for tool-bit holders.

To slot the tool holder, drill a $\frac{1}{2}$ " hole through it as shown, and clamp it to the compound rest with the holding stud. An end mill is placed in the headstock, and the block is shimmed up so that the bottom of

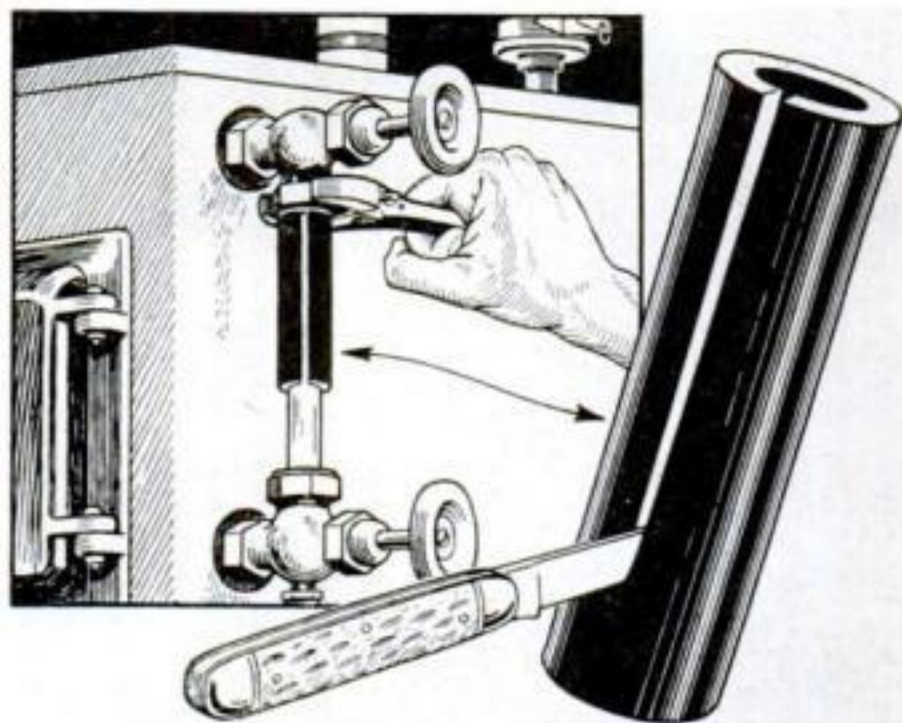


The large slot in the holder is used for various turning tools, and the other slot for a parting tool

the milling cutter will cut a slot that will be $\frac{5}{8}$ " below the center line of the lathe when the block is later clamped directly to the compound rest without shims.

The slot on the other side for holding a parting tool is cut in $\frac{7}{32}$ " deep with a $\frac{7}{16}$ " end mill. Its height depends upon the lathe on which the holder is to be used. Next, insert a $\frac{1}{8}$ " key-seat cutter and mill this slot as shown.

The tool bits are held with hollow-head safety set screws. The regular tool-post wedge is used to adjust the height of the cutter bit.



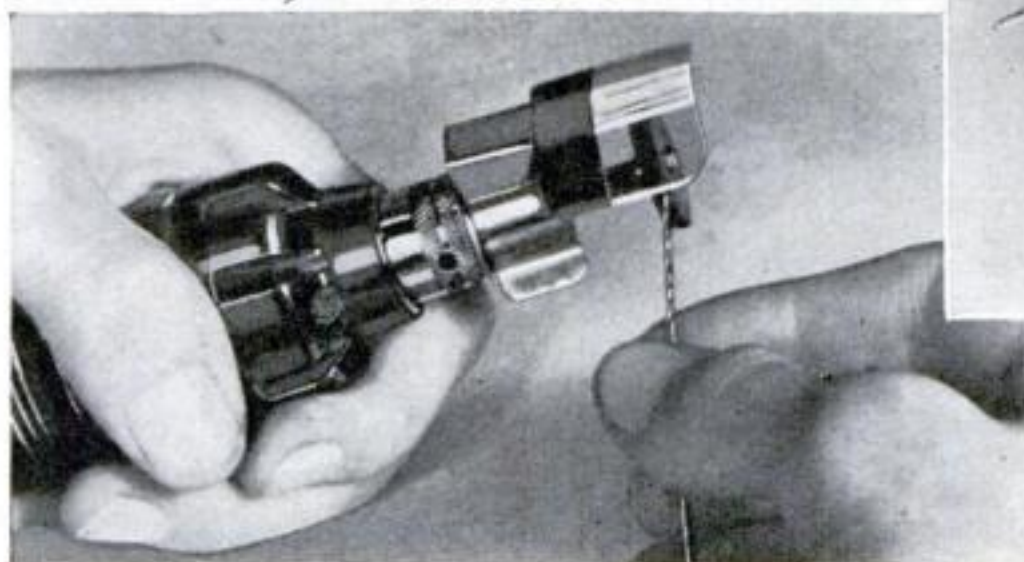
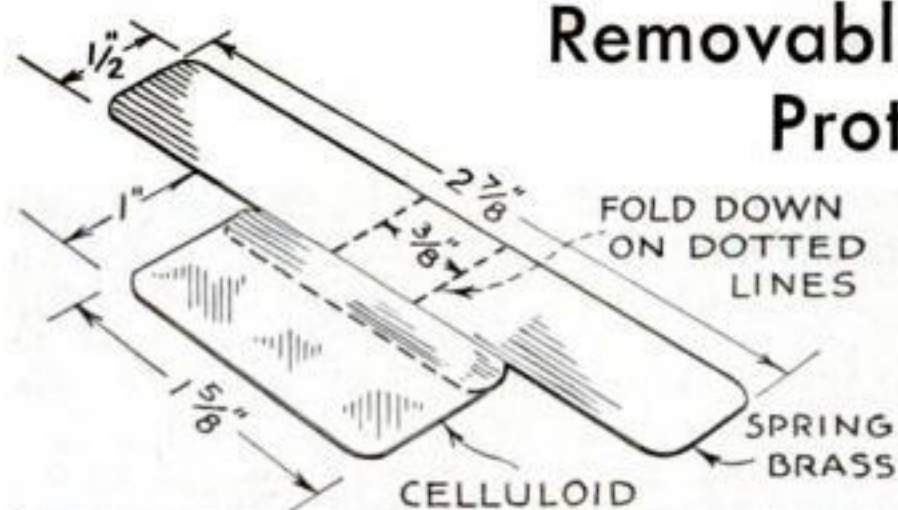
Hose Prevents Breaking New Gauge Glass

WHEN the glass tube of a water or steam gauge is being replaced, it pays to protect it with a slit length of rubber hose. This is pushed to the end where the wrench is being applied and prevents breakage in case the wrench slips.

...

THE cutting edge of a carbide-tipped tool should never be as thin as if the tool were made of high-speed steel.—H. J. C.

Removable Guard on Hand Grinder Protects Eyes from Grit



The clip is bent from spring brass and has a "window" of clear celluloid



MADE for use with abrasive wheels on high-speed hand grinders, this little guard will protect the eyes from flying particles. It is cut from thin spring brass to the shape shown, and the clips are bent to grip the chuck sleeve firmly. Approximate dimen-

sions are given, but slight alterations may be necessary to adapt the guard to other style grinders. A piece of clear celluloid or cleaned photo-film stock is cemented to the metal extension. When the cement has set, the metal is bent.—H. H.

Battery Clips Serve as Clamps

EXCELLENT clamps for gluing model parts or other small work can be made from battery clips of the type shown. These have strong jaws and will hold firmly any work within their capacity. To protect the surface, provide each clip with a pair of wood blocks, slotted to fit over the edges of the jaws.



FORGE WELDING, PART 1

[METAL WORKING]

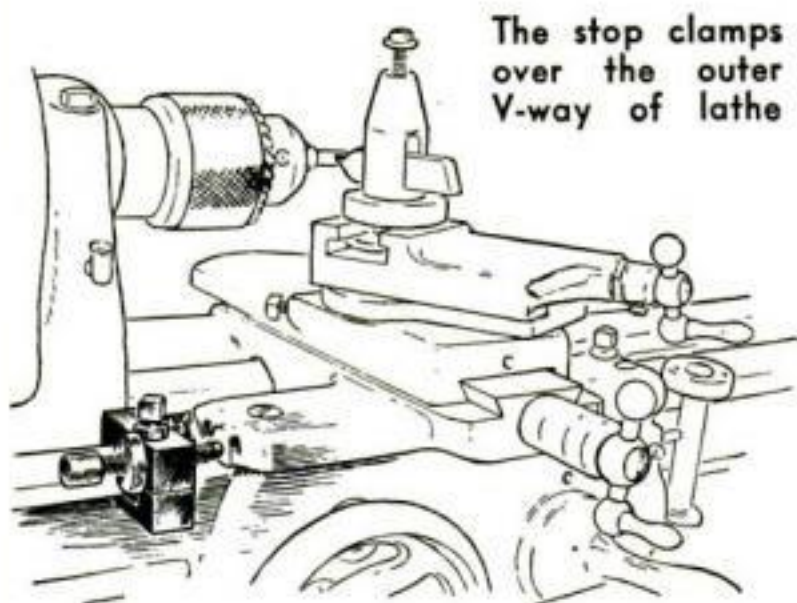
1. A clean fire, free of ash and dirt, is required. It should be built from a good grade of soft coal, well coked; that is, with all the oils heated out of it. The fire must be packed down, and all coke broken into small pieces.

2. Both pieces of metal must be evenly heated and both brought to a welding heat at exactly the same time. Welding heat is determined by watching the flame over the fire for "steel stars" seen coming from the pieces being welded.

3. As soon as welding heat is reached, the pieces must be handled quickly before the metal has chance to cool. Be sure that both pieces are sparking. On way to anvil, tap both pieces gently to jar off any dirt sticking to them.

4. Overlap pieces on the anvil in the position in which they are to be welded and *tap gently* at first with the hammer. As the pieces cool, increase the hammer pressure.

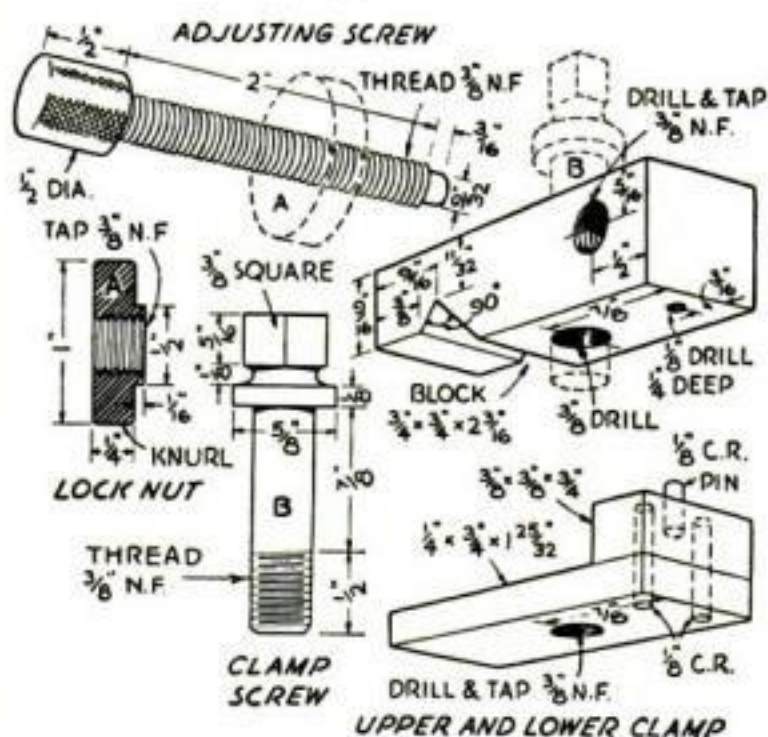
POPULAR SCIENCE MONTHLY SHOP DATA FILE



The stop clamps over the outer V-way of lathe

Simple Adjustable Stop for a Lathe Carriage

THIS adjustable lathe-carriage stop, which clamps on the outer V-way of the lathe as shown, is a useful accessory. The upper half is cut from a piece of $\frac{3}{4}$ " by $\frac{3}{4}$ " by $2\frac{3}{16}$ " stock. The lower clamp is a piece $\frac{1}{4}$ " by $\frac{3}{4}$ " by $1\frac{25}{32}$ " to which is riveted a piece of $\frac{3}{8}$ " square stock. The clamping screw is turned from $\frac{5}{8}$ " cold-rolled stock, the adjusting screw from $\frac{1}{2}$ " stock, and the lock nut from 1" stock. Note the dowel pin.—A. S. BLOOM.



Scale on Drawing Board Is Aid in Drafting

IN CERTAIN types of drafting where many horizontal lines have to be ruled, it saves time to attach a transparent celluloid rule to the board with short, countersunk wood screws. The left-hand edge of the board is first sanded to a depth corresponding to that of the scale used. A second rule may be placed along the top edge of the drafting board, if desired.

As a temporary expedient, a dressmaker's cloth measuring tape may be held in place with thumb tacks. Do not, however, try to use the cloth tape continually, for it will soon wear out.—E. T. ORCHARD.

A rule is attached flush with the board. A tape may be used temporarily

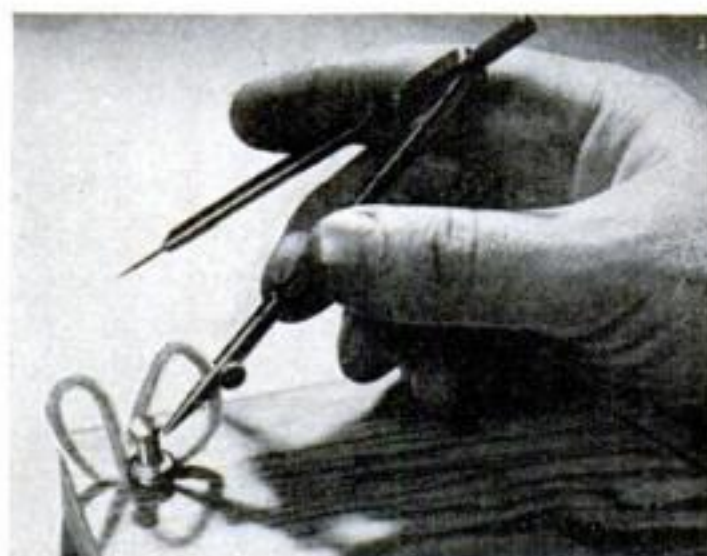


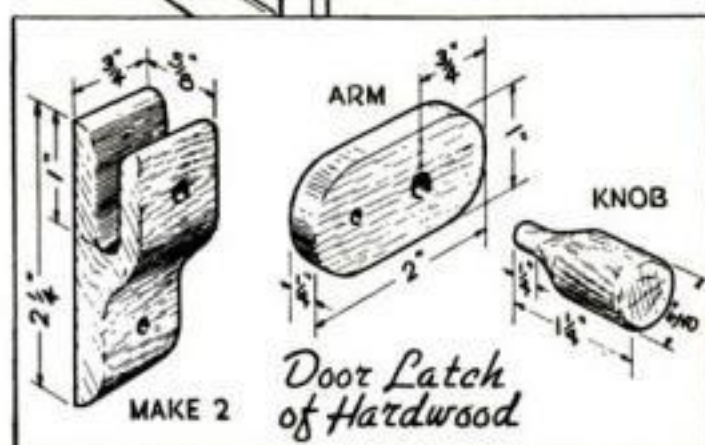
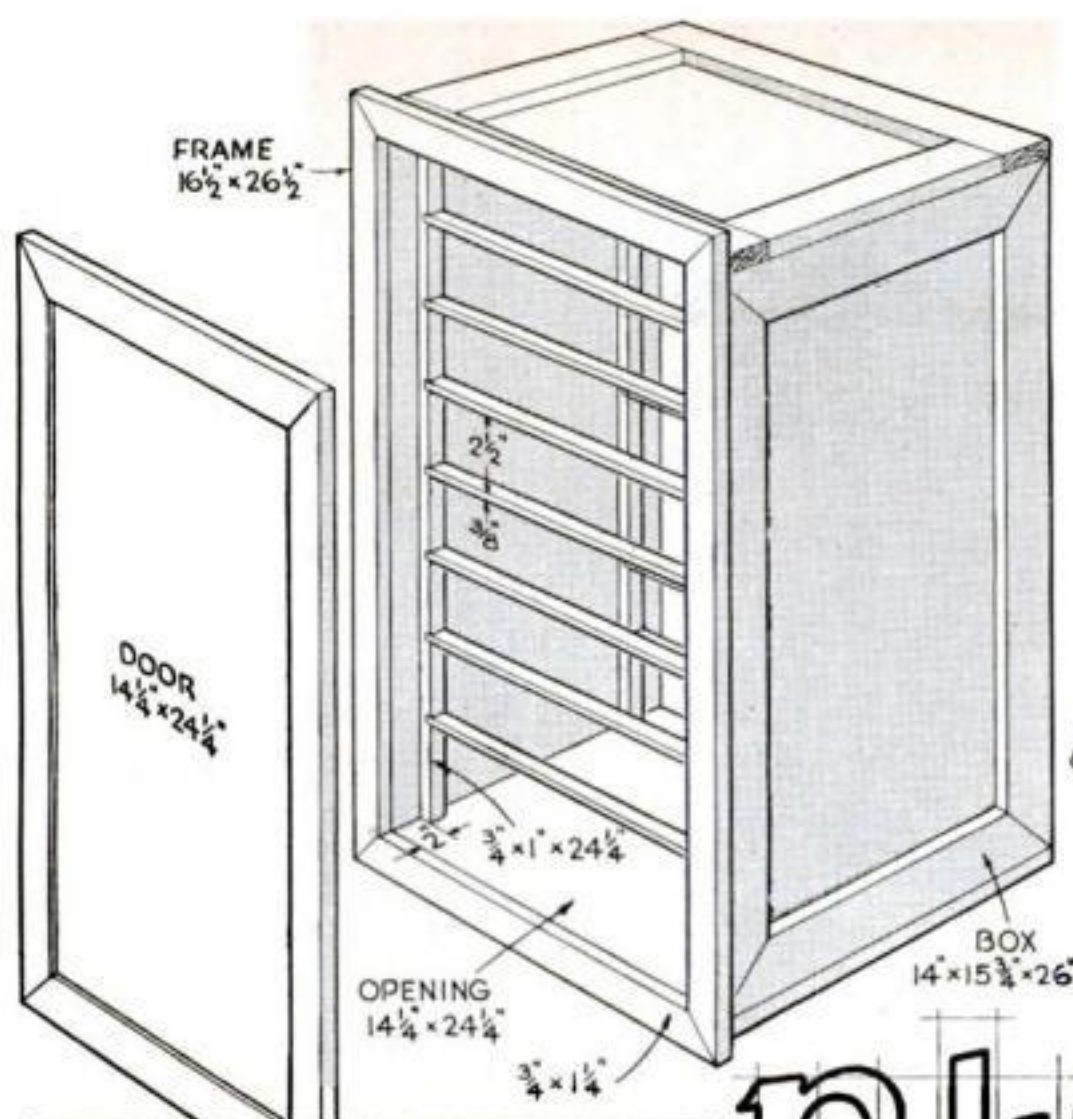
Restoring Burred Threads

ONE method of restoring a burred thread on the end of a shaft or bolt is to use an extra nut of the same pitch. Saw this in half and clamp the halves on the thread, back of the portion that has been damaged. Apply a heavy oil, then screw the half nuts out towards the end.—C. H.

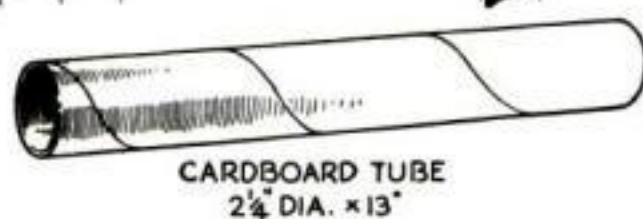
Pipe Cleaner Pinned to Board Serves as a Pen Wiper

FOR cleaning either ruling pens or ordinary steel pens, a pipe cleaner is much more convenient than a cloth. The cleaner can be fastened to the corner of a drawing board with a push pin as shown at the right. One movement with a drawing pen removes all the ink. The cleaner is easily removed and another substituted when it starts to become dirty from use.—O. B.





Blueprints



Blueprint Cabinet Built from a Packing Case

EVERY shop requires a place to keep the blueprints, drawings, and flat plan sheets that are bound to accumulate. A neat, roomy cabinet for this purpose may be made from an ordinary plywood packing case. Measuring from one end, mark off a section 15 3/4" wide, 14" deep, and 26" high and cut this out. Then, from the material left over, cut a fourth side and nail it on so the whole forms a small box.

Two ladderlike sets of spacers 1" wide are next prepared, the sidepieces being 3/4"

thick and the crosspieces or shelves 3/8". These are inserted near the front and the back of the box as shown. A door frame of 3/4" by 1 1/4" stock is also made and nailed on the front of the box, and a door is constructed to fit. A wooden latch for locking the cabinet can be added.

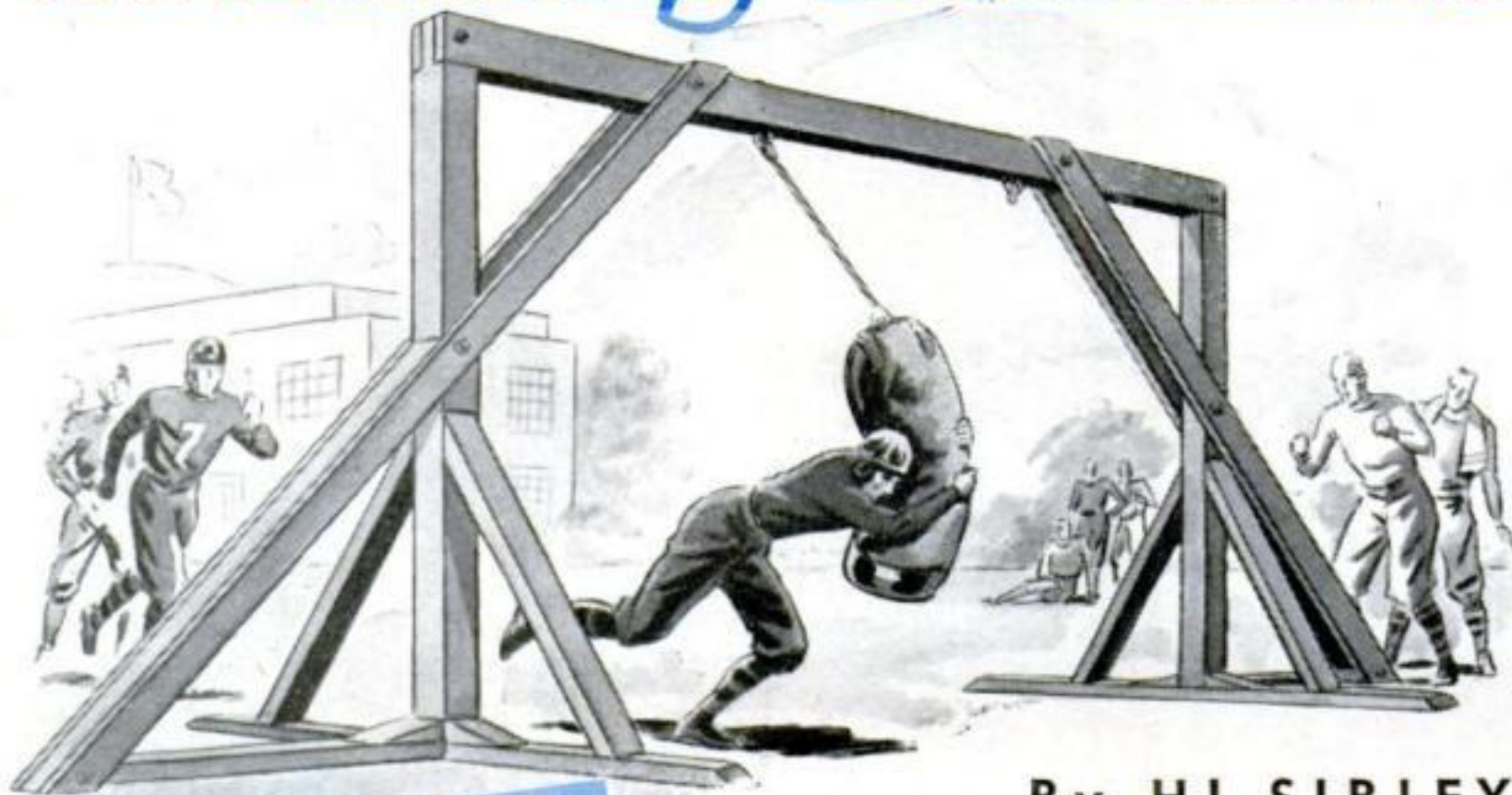
The cardboard tubes for holding the blueprints are 2 1/4" in diameter and 13" long, with adhesive-tape labels. The index is lettered or typewritten on paper and tacked inside the door.—CHARLES JEGLINSKI.

Cement and Linseed Oil Seal Pipe Joints

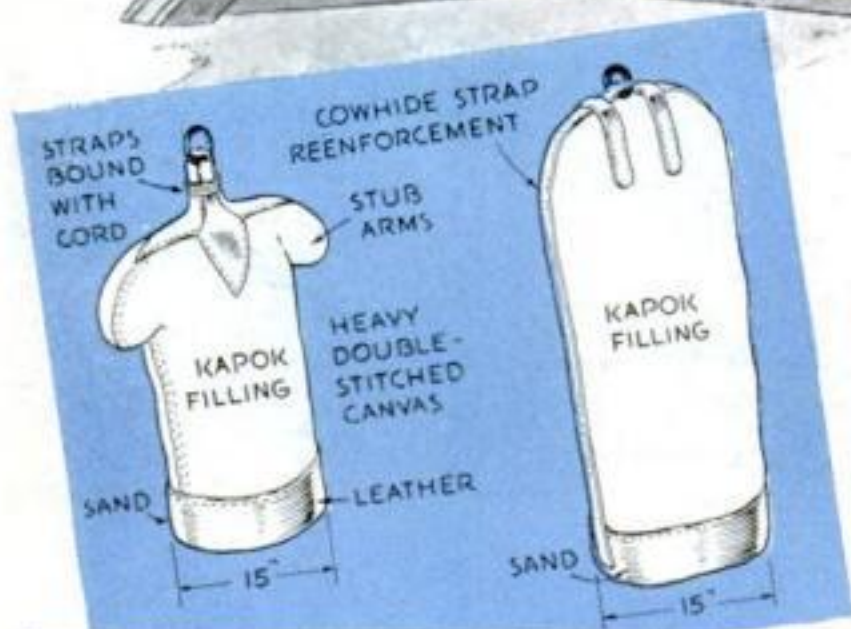
ONE plumbing firm saves money by sealing water and steam pipe joints with a mixture of Portland cement and boiled linseed oil. This has been found as satisfactory as the usual lead mixture. There is always much unavoidable waste of any pipe cement, but with the cheaper mixture this is no longer of much consequence.—R. O. L.



Tackling Dummies



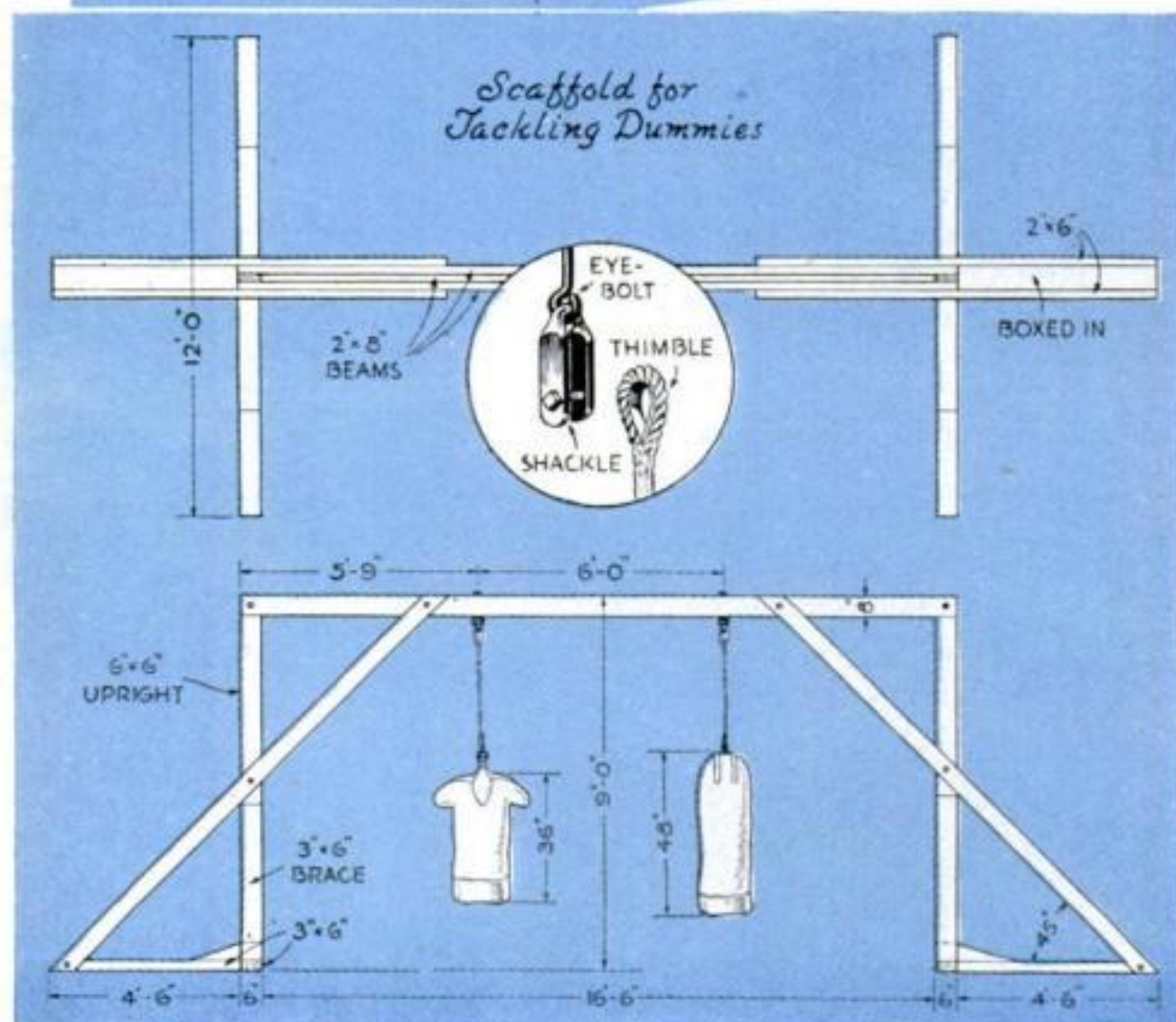
By H I SIBLEY



TOUGH materials and heavy reinforcement are essential in making tackling dummies for a football squad. Athletic coaches usually have favorite designs to suit their own special training technique, but the accompanying illustrations show two types adaptable to all-around use.

Each dummy is made of heavy canvas with a leather boot on the bottom. The ring for suspension is secured with leather straps, double stitched as indicated. The bottom is filled with sand to the required weight, and the upper part is stuffed with kapok or similar upholstery material that will not pack.

One coach suspends two dummies from a scaffold as shown in the drawings, one of them with about half as much sand weight as the other. The rope should be hung over a thimble unless a spring or pulley suspension is preferred. The scaffold timbers are of the dimensions given, assembled with $\frac{1}{2}$ " carriage bolts. This particular design is very sturdy, and has been in use by the champion Pasadena (Calif.) Junior College



AND OTHER FOOTBALL TRAINING EQUIPMENT



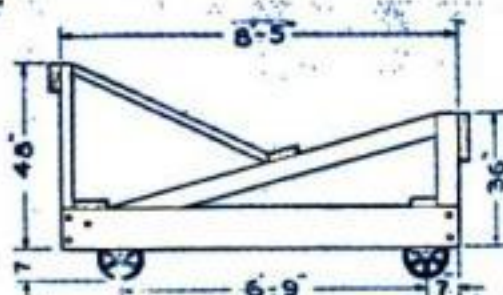
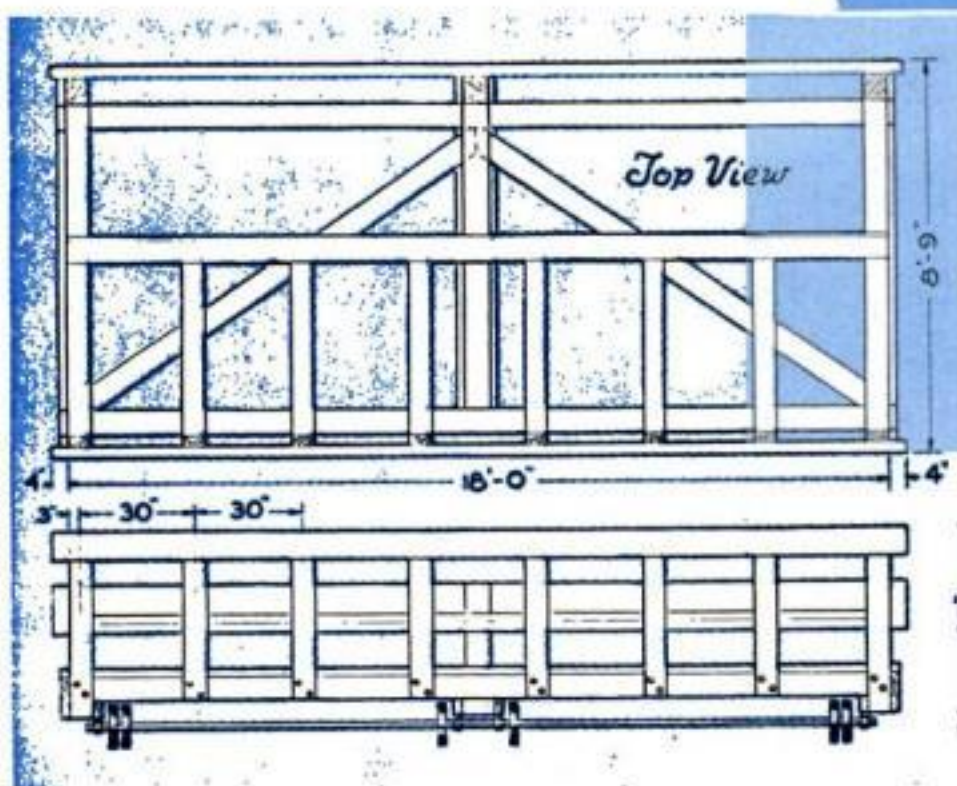
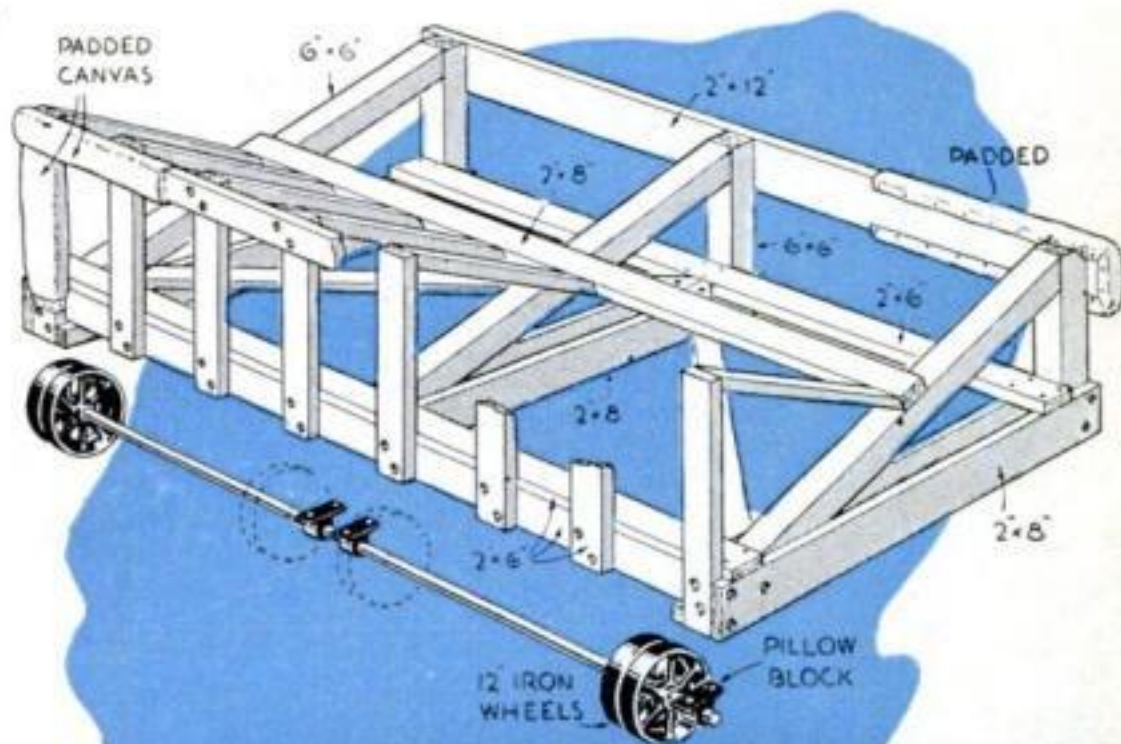
team for several seasons with great success.

The same team uses the bucking machine shown in other illustrations. It is built of heavy timbers assembled with $\frac{1}{2}$ " carriage bolts and mounted on six pairs of iron cultivator wheels. The axles turn with the wheels and are mounted in stock pillow blocks (plain bearings), which can be obtained from a hardware dealer or mail-order house. The corners of all exposed timbers should be rounded to prevent injury from splinters. The uprights are padded, as are the long horizontal members on each side. A slate gray is the most suitable color for painting the framework.

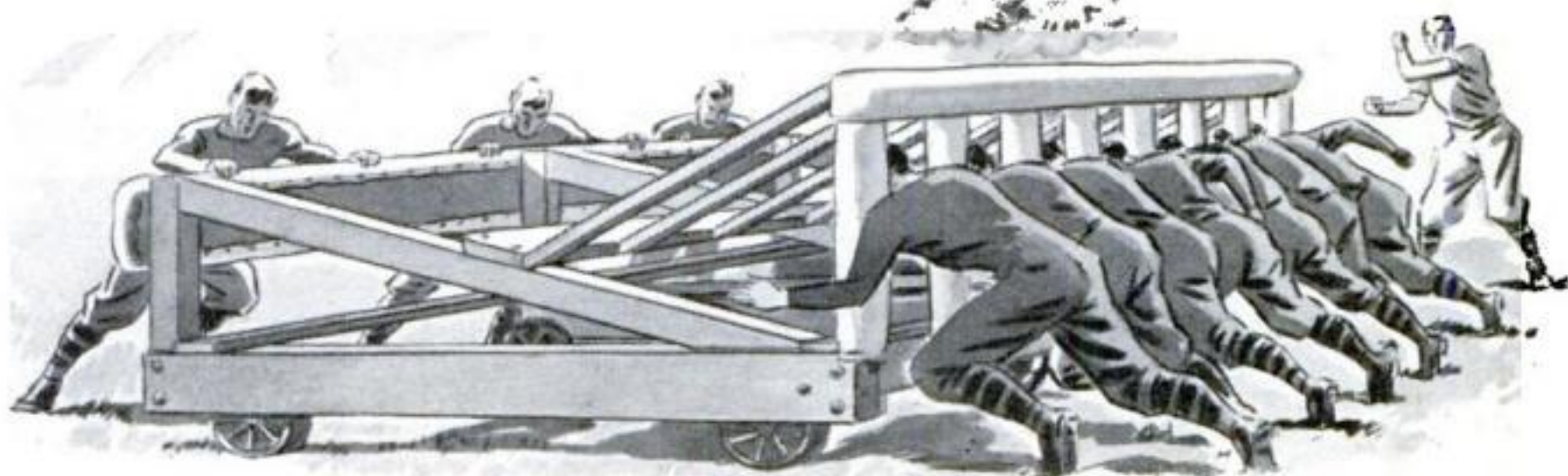
Naturally, such a huge device is not intended to be pushed easily. With its great weight, only two or three men are required on the defensive side to give the seven forwards a thor-

ough workout. The machine should be used only on hard, dry ground because the wheels would bog down in the mud in wet weather.

This equipment is used by a team averaging about 180 lb. For lighter grammar or private-school teams, smaller timbers may be used, such as 4" by 4" or 5" by 5" instead of 6" by 6".



This heavy bucking frame is big enough for seven men at a time, with two or three on the other side for opposition



Cheese Bait Is Improved by Cooking with Match



FISHERMEN who use commercial fish bait of the type made from cheese often find that it dissolves quickly in the water or becomes dislodged from the hooks because of its crumbly nature. To prevent this, one fisherman says that it is necessary only

to mold the bait on the gang hook in the usual manner, then hold it in the flame of a lighted match to sear the cheese around the outside.

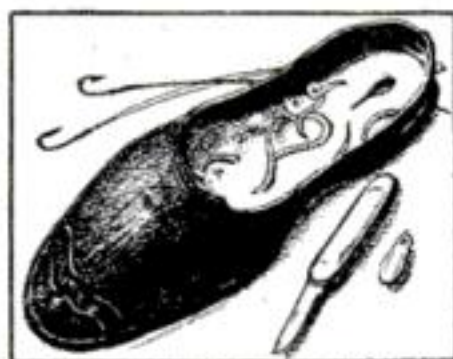
This cooking, he claims, gives the bait a rubbery consistency so it stays firmly on the hook, and also seems to make it more attractive to the fish.

With a handle on the bottom, the basket is easily swung up and emptied into a barrel



Handle Under Bushel Basket Helps in Emptying It

FARMERS and gardeners will find that a leather or rubber strap, if attached to the bottom of a bushel basket, will aid in emptying the contents into bins or barrels. The strap should be twisted once before the ends are riveted in place, as this makes it easier to insert the fingers.

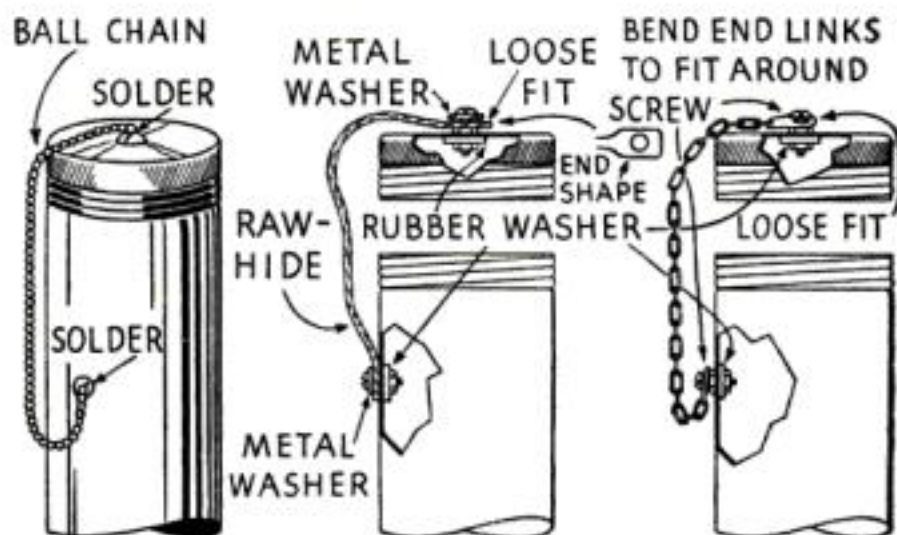


Anglerworm Bait Carried in Old Storm Rubber

A DISCARDED storm rubber, being noiseless and free from sharp edges, serves much better than a tin can to carry anglerworm bait in a boat. It is placed flat upon the boat seat for selecting the worms, but at other times it hangs from a nail or hook where it is out of the way.—G. H.

Easy Ways to Fasten Cap to Fishing-Rod Case

THE caps of aluminum fishing-rod cases are all too easily lost or dropped overboard. This can be prevented by the simple expedient of fastening the cap to the case by one of the three methods illustrated below. Note the swivel arrangement required for rawhide or link chain; ball chain does not require this. Use soft rubber washers, as shown, to insure water-tightness at the connections.—R. C. R.

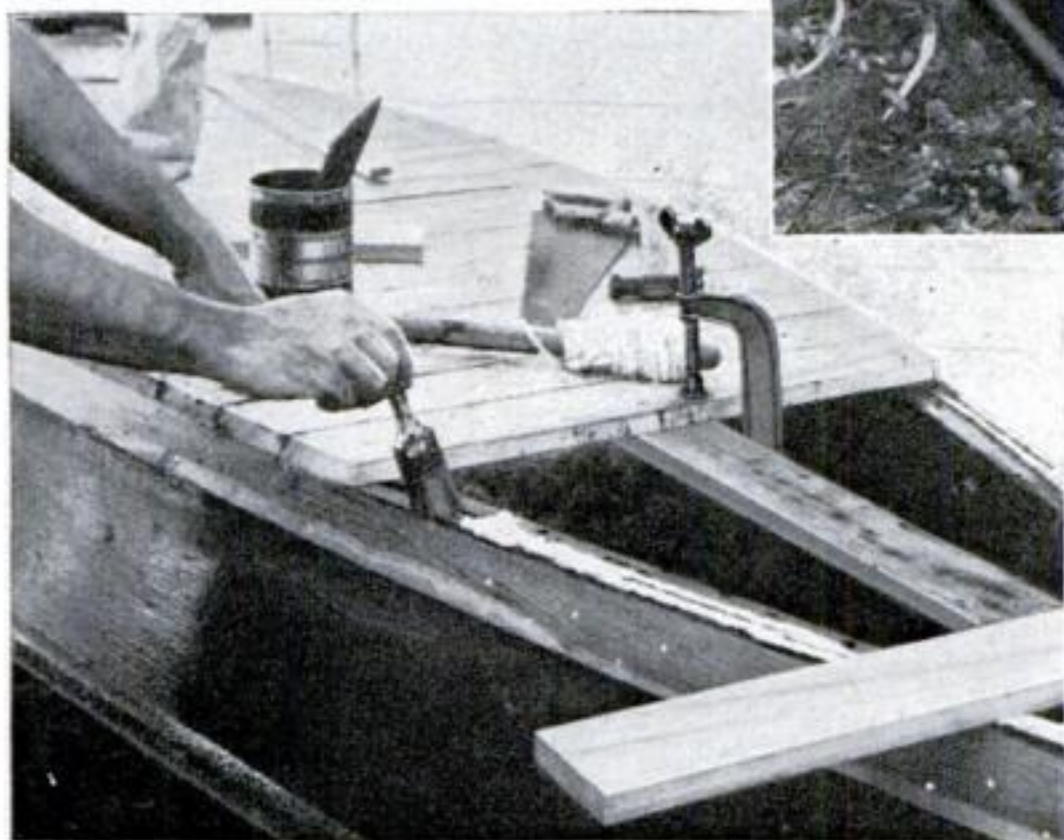


Replanking A FLAT-BOTTOMED Rowboat

By Bruce and
Willard Crandall



Plane the surfaces of the chines and side planks perfectly smooth. Left, use cotton wicking soaked with marine glue or white lead to make all the seams water-tight



NO SPECIAL skill or knowledge of boat building is required to replace the bottom of an ordinary flat-bottomed rowboat, provided the sides and other parts of the boat are in good enough condition to make the job worth while. In most cases the materials will cost less than five dollars.

In the boat shown, the chines as well as the entire bottom, outside keel, and skeg had been destroyed by marine borers, so it was essential to put new chine pieces on the outside of the boat. Ordinarily this would not be necessary.

Excessive swelling of the planks is one thing to guard against because it causes buckling and leaks at the chine. This is likely to result from the use of material that has been too well seasoned or kiln dried. It usually can be minimized by using narrow planks, 4" or less, and by not forcing them tightly together. White cedar and cypress are generally the most satisfactory woods, although other woods such as red cedar, spruce, fir, redwood, and yellow or white

pine often give very good results.

After the old planking has been removed, the edges of the side planks and chines should be planed smooth. Keep them flat so that the planking will fit perfectly. It is usually best to start laying the planks in the middle,

but check first to see how well they come out at the bow and stern.

Before the planks are put in place, a couple of strands of cotton wicking should be laid along the edge of the chines and transom. The wicking and the edge of the side plank, chine, and transom should be coated with marine glue, soft white lead, or thick paint. Lay a similar strip of cotton wicking on the edge of each bottom plank before the next plank is put in place.

The bottom planking should be fastened to the chines and side planks with brass or galvanized screws or galvanized nails, spaced about 1½" apart. The planks should be sawed off flush with the sides as the work proceeds. Do not clamp or force each plank too tightly against the next one, but leave the seam open at least the thickness of a hack-saw blade. You may, if you wish, determine by experiment ahead of time how much a plank of the particular lumber you are using is likely to swell, and make the seams accordingly.

Another way of making the bottom seams

water-tight is to calk them after the planks are in place. In this case the edges of the bottom planking should be beveled slightly to make a calking seam, which is closed on the inside but left open about $\frac{1}{16}$ " on the outside, to receive the calking later.

If the bottom planks fit perfectly, it is often not necessary to have any kind of calking or anything whatsoever between the seams of a flat-bottom boat. Planking less than $\frac{5}{8}$ " should not be selected unless some special type of construction, such as batten-seam, is followed. Never use ordinary tongue-and-groove material. If extra light weight is desired, the bottom can be covered with a single piece of marine plywood $\frac{3}{8}$ " or $\frac{1}{4}$ " thick instead of planking. Cut it with a fine-toothed saw.

After the bottom is in place, the edges should be planed smooth and flush with the side planking, and the outside keel and skeg



With only a few tools anyone can install a new bottom on a flat-bottom rowboat. Narrow planking prevents swelling and buckling

added, as desired. Copper paint should be used if the boat is to be left in salt water; otherwise, regular marine paint will prove satisfactory.

Ball Aids in Throwing Rope over House Roof

WHEN it is necessary to carry a rope over the top of a house to pull up ladders and rigging or for other purposes, attach one end of a fishline or kite string to a soft sponge-rubber ball and the other end to the rope. Then throw the ball over the roof and pull up the rope. The advantage of using a rubber ball is that it is not likely to break a window pane if it goes askew when thrown awkwardly.—CARL L. SAWYER.

Bigger Flukes Improve Light Rowboat Anchor

TO INCREASE the holding power of a light rowboat kedge anchor, saw out two triangular-shaped pieces of galvanized iron about $\frac{1}{8}$ " thick and about three times the area of the present flukes. Then rivet them flat onto the flukes. If desired, coat the anchor with aluminum paint.



The triangular pieces increase the holding quality of the anchor



Rubber Shock Absorbers for Hedge Clippers

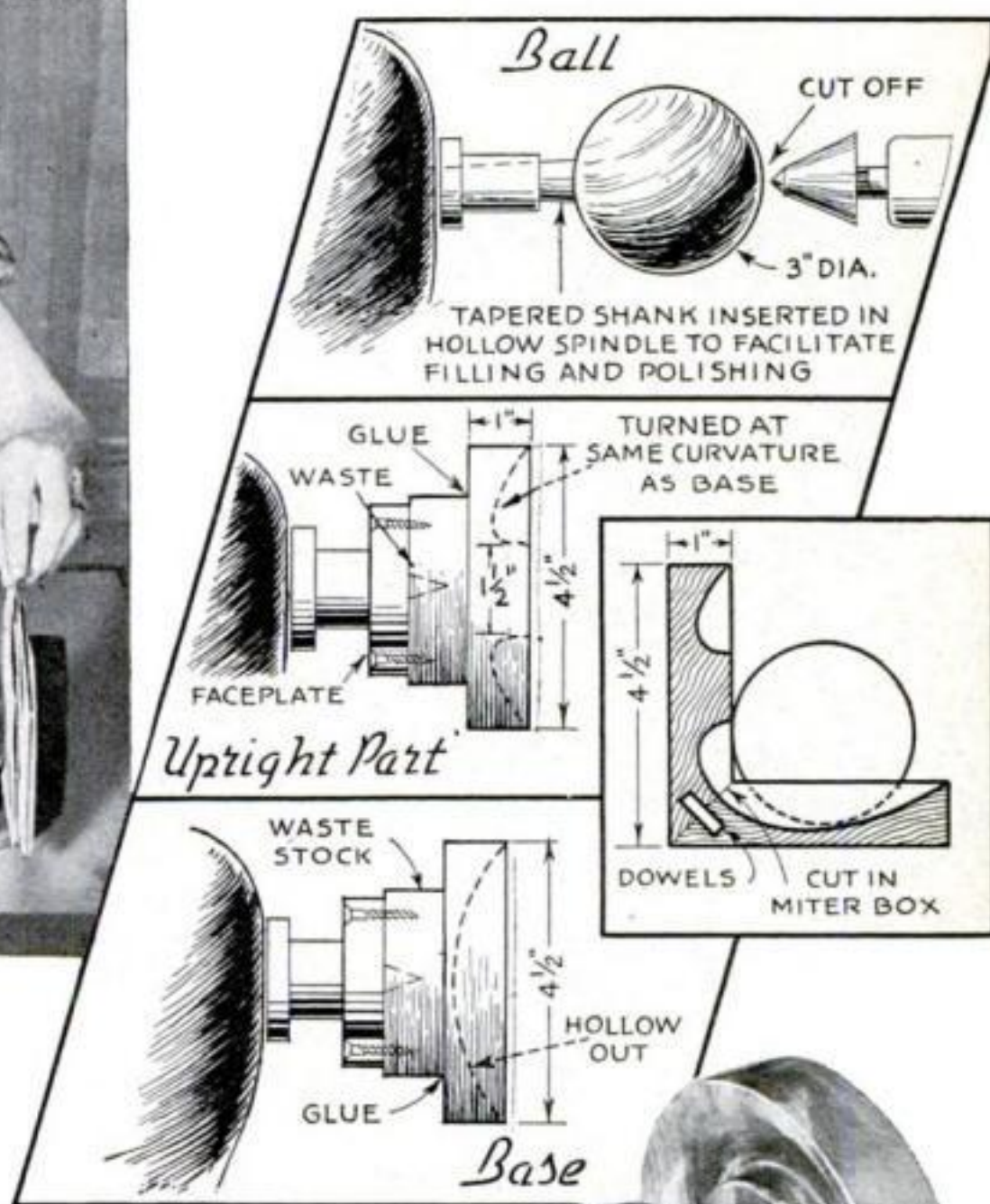
HEDGE-TRIMMING shears of the type shown will not cause an annoying shock or jar to your arms if you cut two short lengths from an old garden hose, slit them open along one side, and fit them over the ferrules. Fasten them permanently with tacks driven into the wood of the handles.—G. E. H.

Novel Automatic Letter Holder

TURNED FROM WALNUT



Left, the letters are held by pressure of the ball, which rolls in toward the upright. Below, how the three parts are turned and assembled



THE simple lines of this modern, automatic letter holder emphasize the natural beauty of the walnut wood from which it is turned. The slope of the base block is such that it causes the ball to roll toward the core or central pad of the upright. The letters are placed between the ball and the upright. No matter how many or how few letters there are, they are securely gripped.

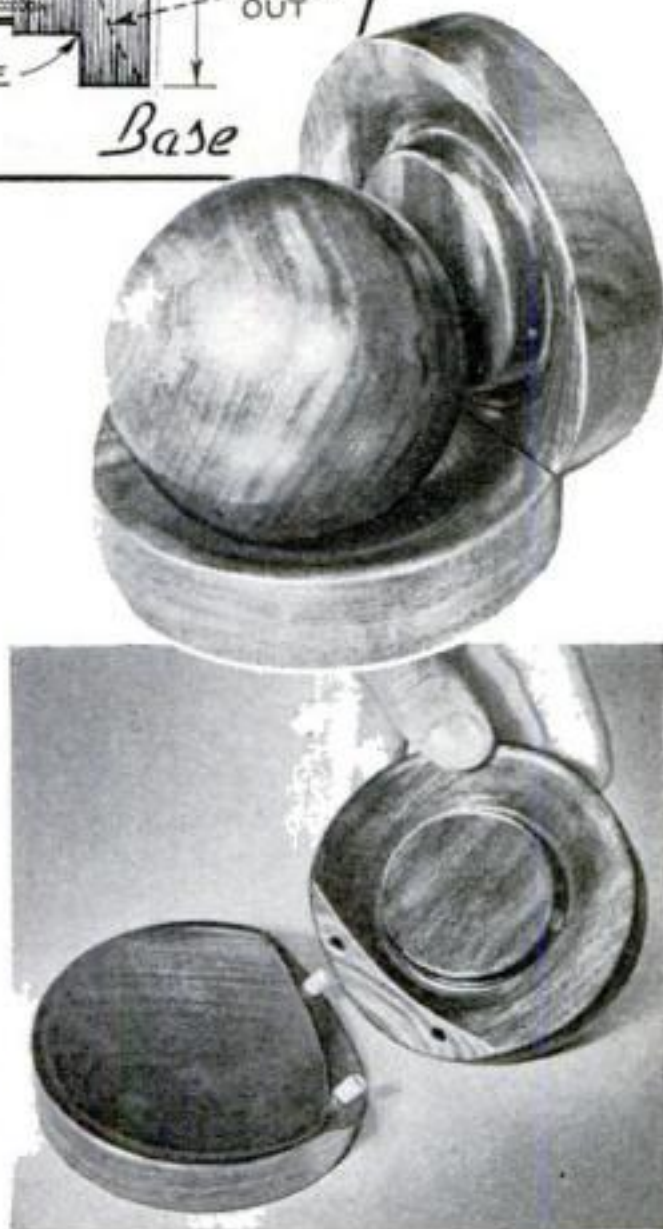
Base and upright, measuring $4\frac{1}{2}$ " in diameter, are turned from 1" thick walnut. The upper surface of the base is hollowed out, and the face of the upright is turned as shown to leave a central core measuring $1\frac{1}{2}$ " in diameter and practically the same thickness as the original block.

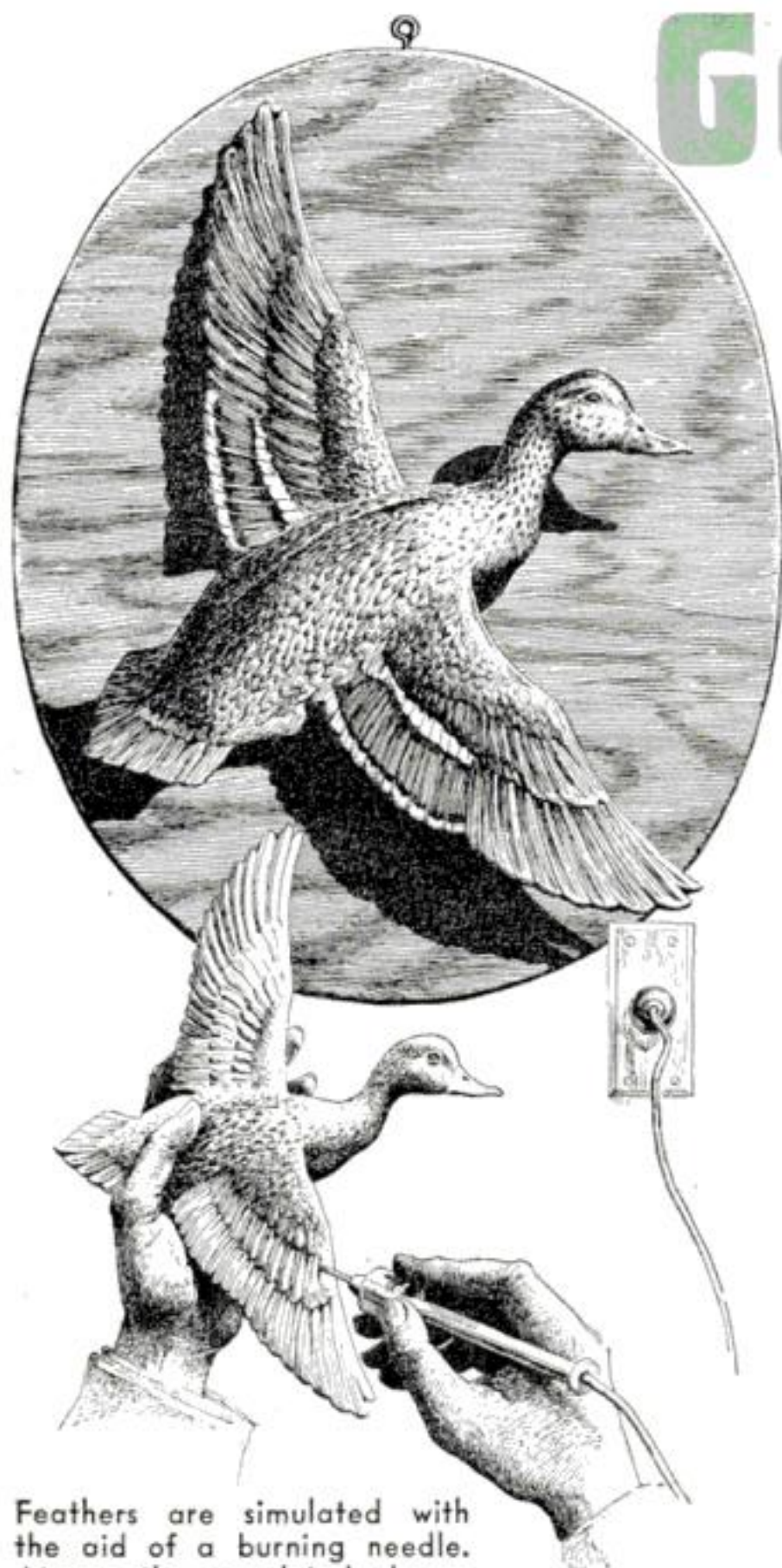
Filler and shellac are applied and allowed to dry. While the work revolves in the lathe, the finish is rubbed down by holding against it a cloth dusted with powdered pumice stone. Then both parts are waxed. The parts are next beveled and fitted together with dowels.

The 3" ball is turned and finished the same way. Note that a tapered shank is turned on the ball and inserted in the hollow spindle of the lathe after the other waste end has been cut off. This is done to facilitate filling and polishing the ball.

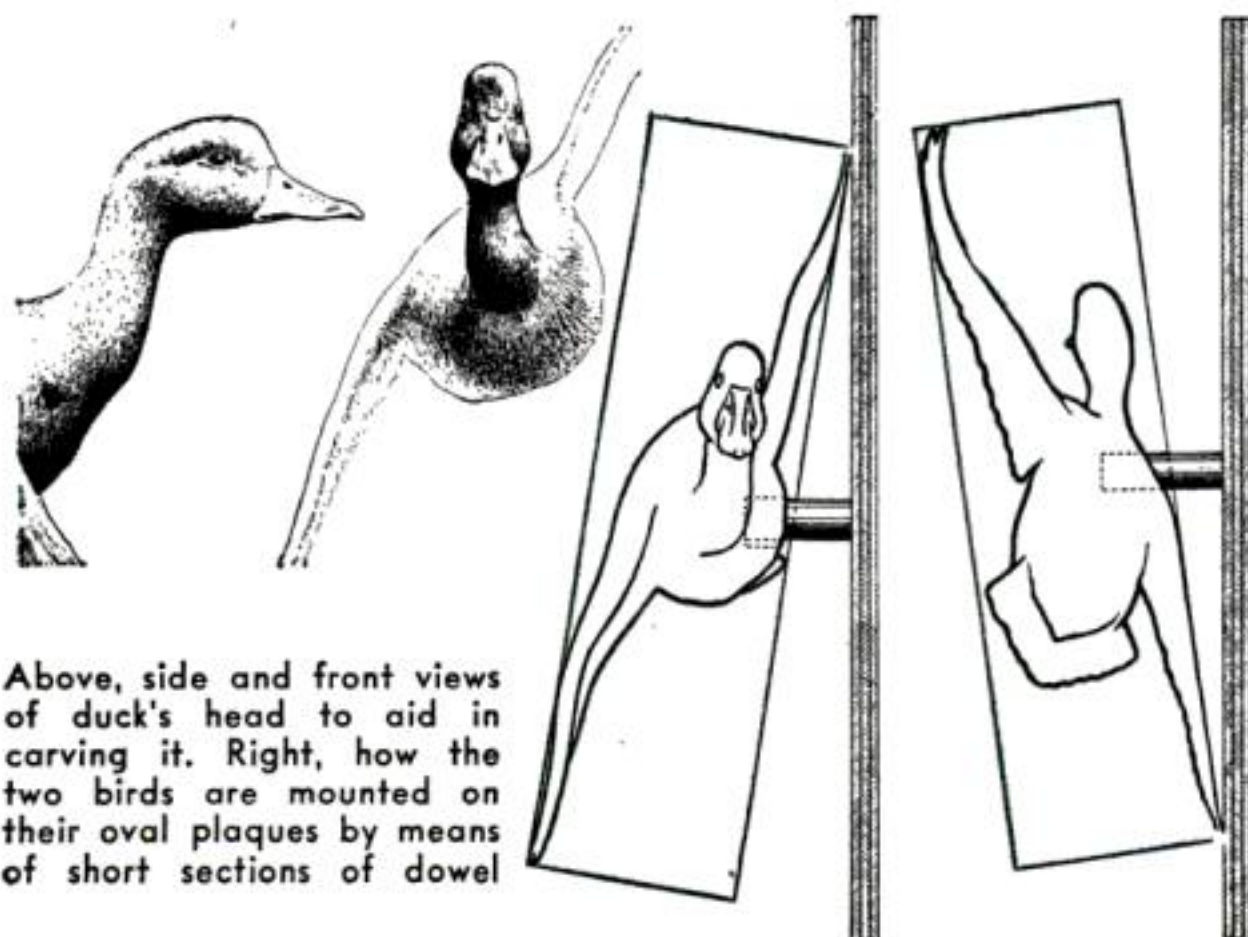
—BENJAMIN NIELSEN.


CLOCKED
PROJECT
Average Time
5 hours





Feathers are simulated with the aid of a burning needle. At top, the completed plaque



Above, side and front views of duck's head to aid in carving it. Right, how the two birds are mounted on their oval plaques by means of short sections of dowel

IT'S EASY TO CARVE THEM IF YOU FOLLOW THE RIGHT METHOD

ANY amateur craftsman with a reasonably good eye for proportion and color can carve and color lifelike miniature game-bird plaques.

The male and female mallards illustrated are made from 2" white pine. The grain should run along the wings if possible. They are carved in what may be called high relief, giving the impression of depth and roundness. When the wings are well shaped, the feathers may be indicated by carving tools or an electric burning needle. The needle also helps in shaping the bill, nostrils, and eyes.

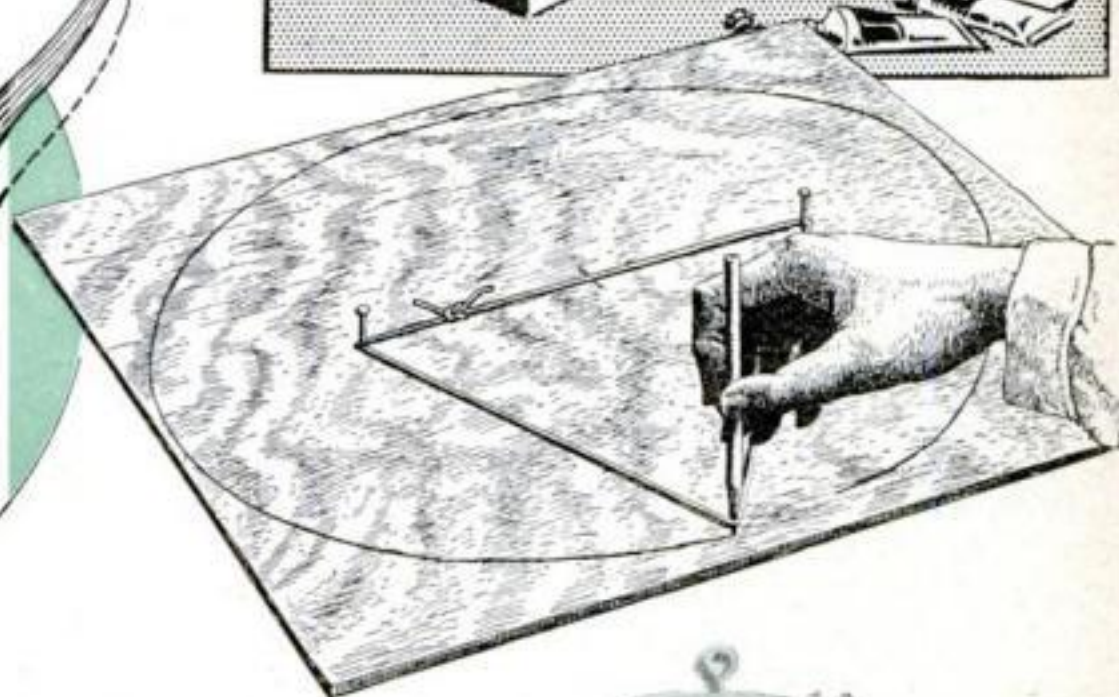
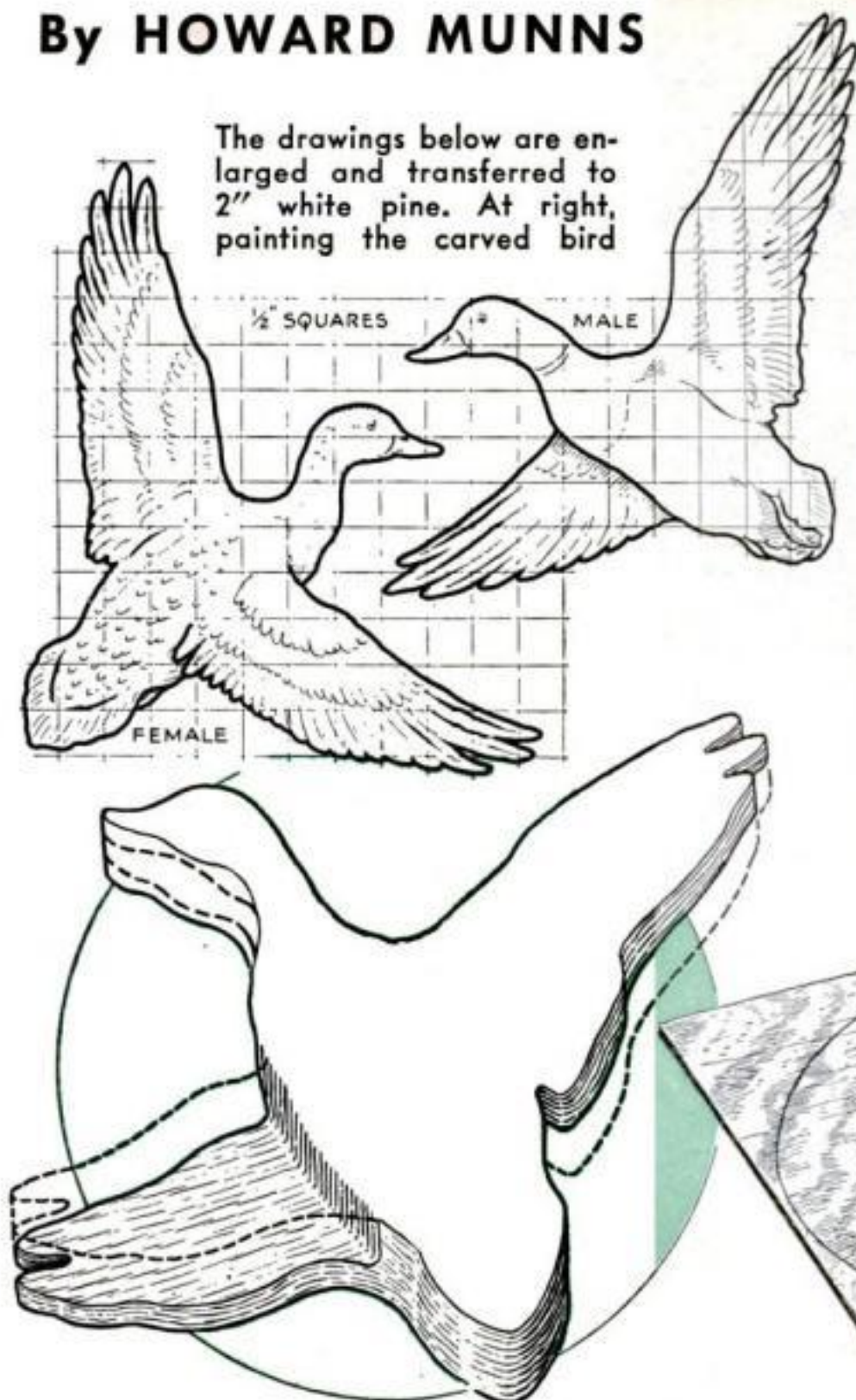
Color plates to copy may be found in any library, and sometimes helpful paintings appear on magazine covers. Flat oil colors are best, except for the head of the male. The peculiar iridescent green sheen of the head may be produced by applying green bronze powder over wet shellac.

The female is painted a light warm brown on upper head, neck, wings, and body, fading to a very light buff on the breast and underbody. The markings on the head and neck are in the form of brown dots, worked into the V-shaped markings of the ends of the back feathers. The wing tips and the wing coverlets are dark brown fading into the warm brown. The color band on the trailing edge of the wing is blue-violet with white bars on each side of it. The bill is a yellow brown, darker on the end.

The coloring of the male is familiar to every

By HOWARD MUNN

The drawings below are enlarged and transferred to 2" white pine. At right, painting the carved bird



How the bird is shaped from the wooden block and method of drawing ovals. Circular plaques could also be used

nature lover: Yellow-brown bill, iridescent green head, white neck band; breast, deep wine-maroon down to just under the wings, blending into warm light gray; dark gray near legs, with underside of tail nearly white; legs, reddish brown; edges of wings, dark brown fading to light gray to the coverlets, which are warm brown fading again to light gray.

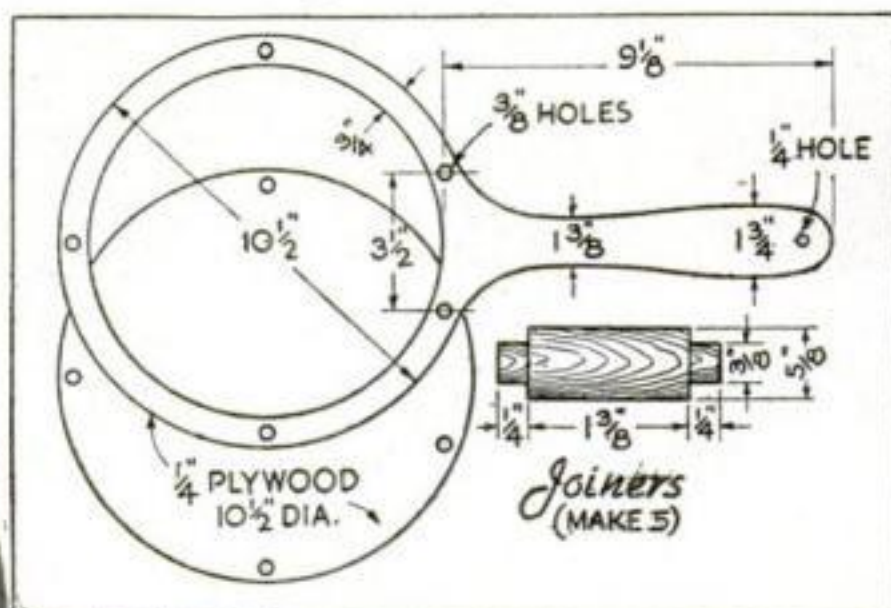
Mount the ducks on plywood panels, round or oval, stained lightly and finished either with a varnish that dries to a satin gloss or a regular varnish rubbed to a satin finish. If, however, a grainless background is preferred, use a neutral-tinted, semigloss enamel. The ducks' bodies are held away from the board by short pieces of dowel as shown on the opposite page. A screw eye is added for hanging.

Pheasant, quail, and game fish would also be adaptable for this sort of craftwork and may be made in the same way.



When carefully carved and painted, the model presents a realistic appearance and will enhance any den. Other birds and fish can be adapted to this type of craftwork

Plywood Serving Tray Is Shaped Like Banjo



Stars are painted or glued on after the tray is coated two or three times with varnish stain.

DESIGNED in banjo shape, this unique plywood serving tray suggests something of the picturesque charm of the Old South. It would make a distinctive gift and, since the construction is simple, two or more of the trays could be made up at one time very quickly.

With a compass and some freehand sketching, lay out the frame and bottom;

then saw them out together. Drill the necessary holes, using caution to prevent the bit from splintering when it comes through. This is best done by backing up the wood with a piece of scrap stock. The pieces may then be separated and the inside cut made.

Turn all the joiners at once, cut them off, and clamp and glue securely. Follow with a thorough sanding and any type of finish desired. One method is to apply three coats of walnut varnish stain, and rub down the last after it has dried for several days. Stars may be either glued on or painted.—**BRUCE MACINTOSH.**


**CLOCKED
PROJECT**
Average Time
2 hours

Chopping Bowl Cut Down for Serving Salads

AN INEXPENSIVE chopping bowl can be transformed into an attractive salad bowl by cutting it on a jig saw to the shape shown. The edges are rounded off and the

whole bowl sanded to smoothness. It is then mounted on three feet, 1" in diameter, turned from maple. The tops of the knobs are sanded flat to fit the undersurface of the bowl. A light varnish stain is applied for a natural golden finish.—**B. B. BRONSON.**



Attaching the round feet to the bowl with screws. The heads are countersunk. At far right, the completed bowl in use.





When pressed into soft plaster of Paris, the child's hand leaves a clear print as at right



Print of a Child's Hand Preserved in Plaster

A PRINT of a child's hand can easily be preserved in the form of a plaster plaque. Obtain a 6" wooden embroidery hoop and cut the inner hoop at one place so it will spring out when the outer hoop is withdrawn from it. Lay a board on a level, solid surface and place a sheet of white paper over it. Fit the cut hoop inside the outer one and lay them flat on the paper.

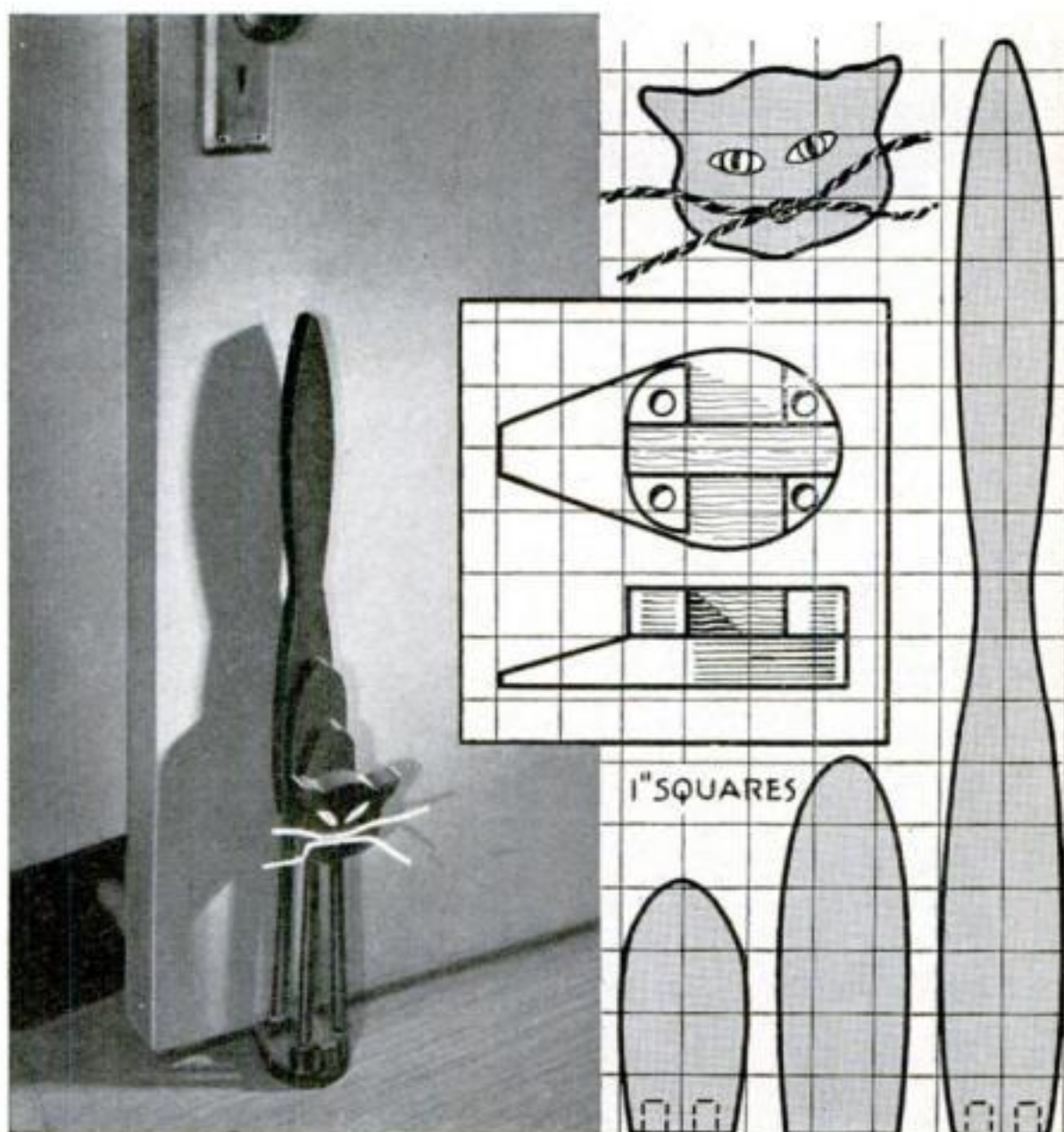
Mix plaster of Paris with water to a thick, creamy consistency and pour it inside the ring. When the mixture begins to harden, place the child's hand in the mold, fingers extended and spaced evenly. Press the fingers firmly, one at a time, and also press the hand itself into the plaster. Hold the hand down for several minutes until the plaster is no longer sticky. After the hand has been withdrawn, let the plaster set for half an hour. Remove the outer hoop, spring the inner hoop away from the plaque, and trim the paper to the size of the plaque. Then let the plaster dry thoroughly.

A pastel-shade paint will give depth to the hand print. For hanging, glue a loop of ribbon securely on the back.—B. P. SMITH.

Comical Wooden Cat Does Duty as a Doorstop

NOVELTY, sales appeal, and economical production by amateur craftsmen were the considerations that prompted the design of this amusing black-cat doorstop. It is another project developed at the New York workshop of the Metropolitan Junior Achievement.

The doorstop may be readily put together from odd scraps of wood. Body, head, tail, and base, are sawn from $\frac{3}{4}$ " stock. The legs are common $\frac{1}{2}$ " dowels. For the whiskers, pipe cleaners are used; and the eyes may be painted directly on the wood, or cut from white adhesive tape and marked with ink.—K.S.





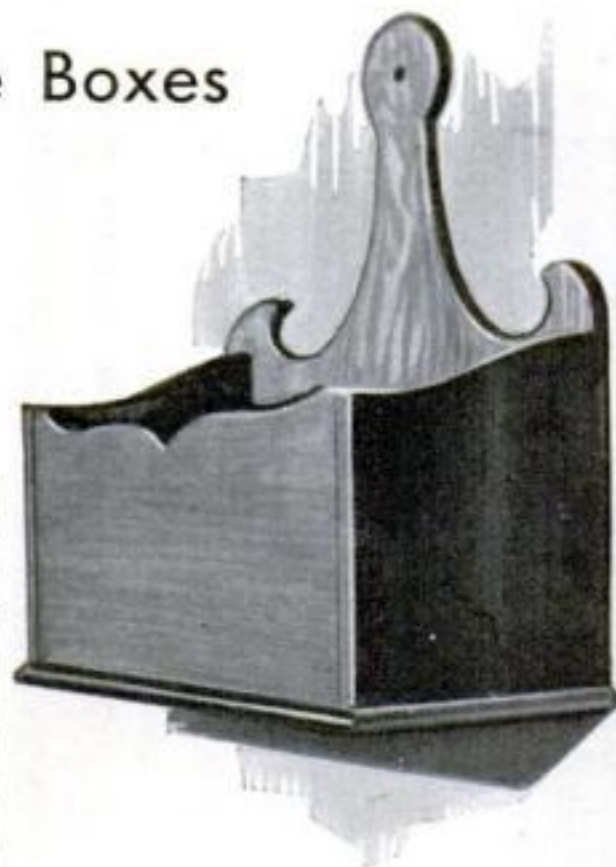
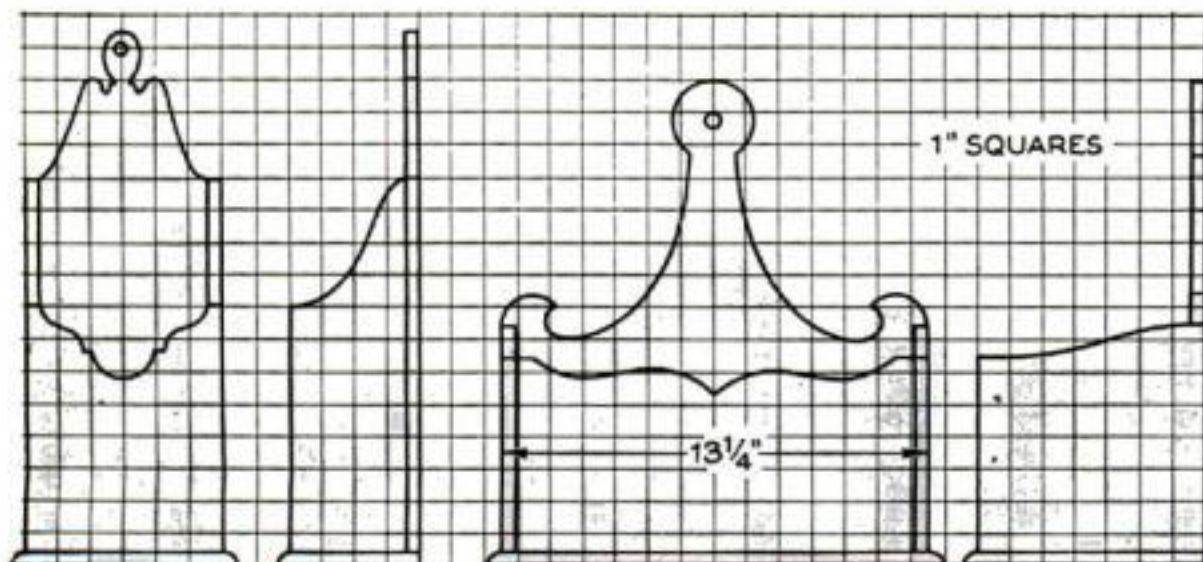
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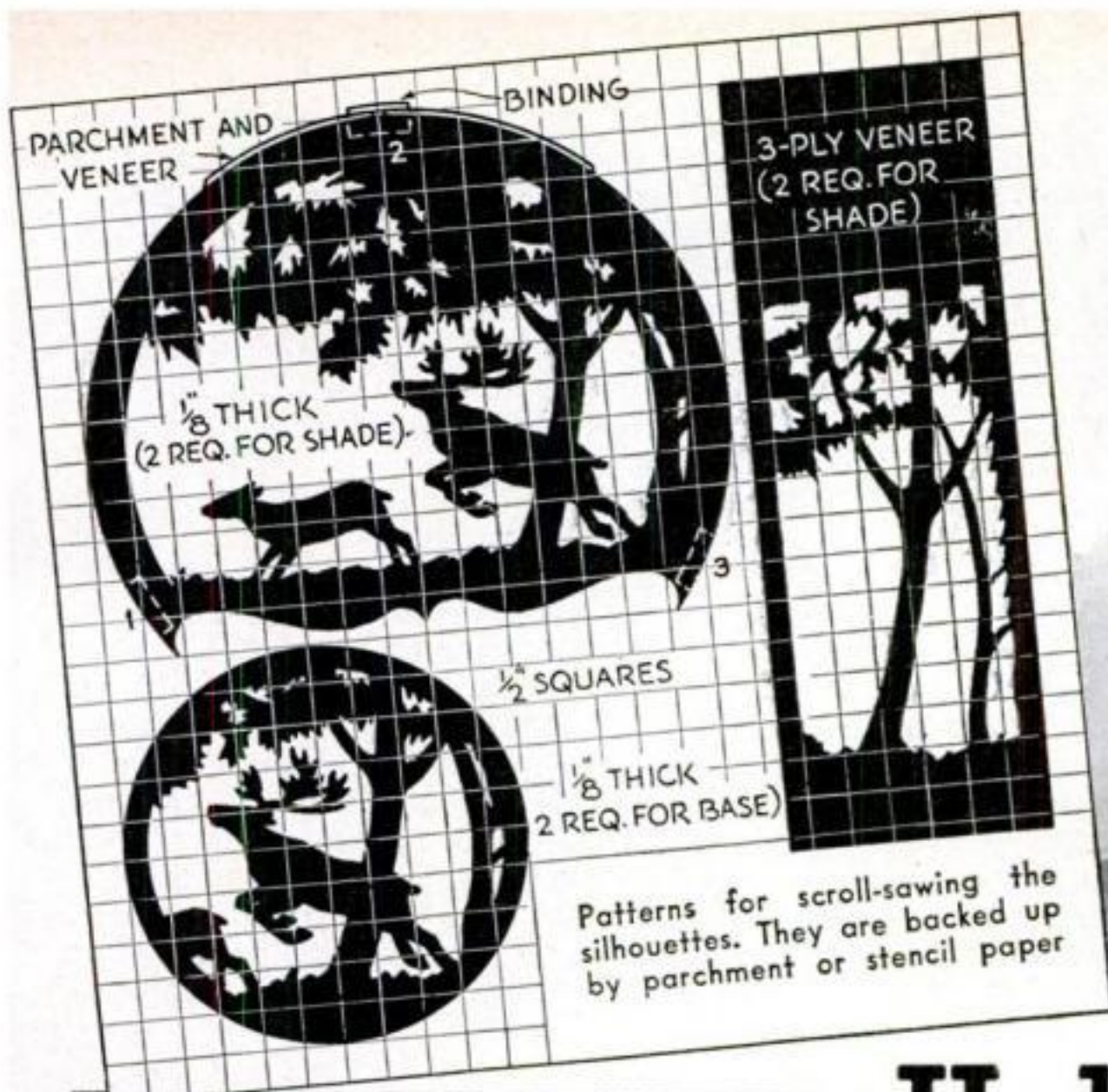
The parts can be given a high gloss in the lathe with French polish (shellac and a little oil) applied on a piece of cloth. If a less glossy finish is desired, rub it down afterwards with furniture wax.—MICHAEL KOLISKO.


**CLOCKED
PROJECT**
Average Time
5½ hours

THE designs for the two boxes drawn below are adaptations of Early American pipe boxes. The large box pictured in its finished form at the right is useful in the hall for gloves and scarfs, while the smaller box can hold letters to be taken to the post office, clothes brushes, or anything of that sort. The boxes are made of $\frac{1}{2}$ " knotty white pine.—HENRY R. DIAMOND.



Scarfs, gloves, and similar articles can be kept in the box above, if hung in the hall. At left, drawings for the boxes



Hall Lamp

DECORATED
WITH JIG-SAWED PANELS



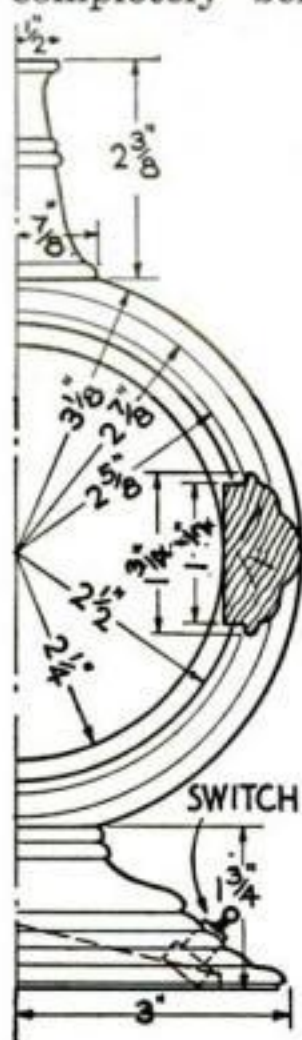
DESIGNED for use in an entrance hallway, this decorative table lamp has a night light built into its lower section. The wooden parts are walnut, although I have duplicated the lamp in both maple and mahogany with equal success.

The turned parts consist of the base, which is 6" in diameter and made from 2" stock; the ring, 6 1/4" in diameter and also made from 2" stock; and the spindle, which is turned from a 2" by 2" by 3" block. Cup out the underside of the base deep enough

to allow for the wiring, and mortise it for the toggle switch. Turn and finish the ring completely before cutting out the inside,

which needs only one coat of shellac or varnish to protect it from moisture. Cut the rabbets to take the fretwork just deep enough to hold the 1/8" wood plus the thickness of the parchment you intend to use as a backing for the silhouettes.

To assemble the turned parts when finished, file a flat place on the ring long enough to contact the flat part of the base. Drill a 3/8" hole in the center and assemble by using a 1/8" nipple 2 1/4" long with a 1/8" nut at each end. To add the spindle, flatten the center bead of the ring and bore a 1 3/4" hole just deep enough to set the



spindle flush on the ring, or, as an alternative, cut a shoulder instead of a bead at the base of the spindle, and carve the shoulder to fit over the beads on the ring. Drill a $\frac{3}{8}$ " hole through spindle and ring. Attach a standard pull-chain socket to a $4\frac{1}{4}$ " nipple, thread through the spindle and ring, and lock with a $\frac{1}{8}$ " nut. On the inside of the ring, screw a candelabra socket.

In wiring the lamp, break one of the leads at the toggle switch; then continue the two leads to the porcelain socket and thence to the pull-chain socket. The toggle switch controls both lamps, but the pull chain controls only the upper lamp. Use a 7-watt candelabra lamp for the night light and a 40-watt lamp under the shade.

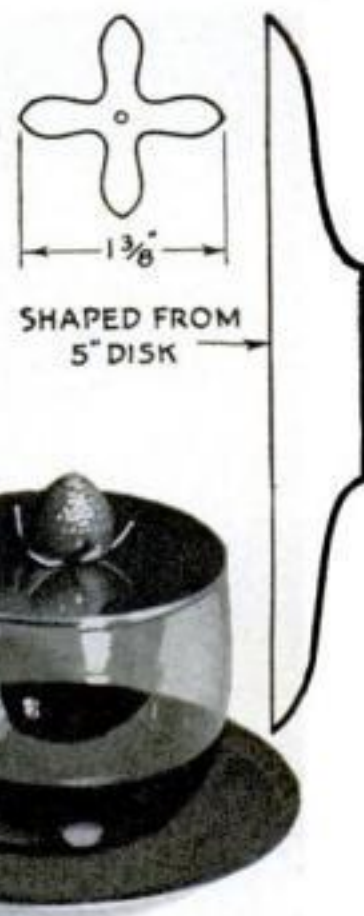
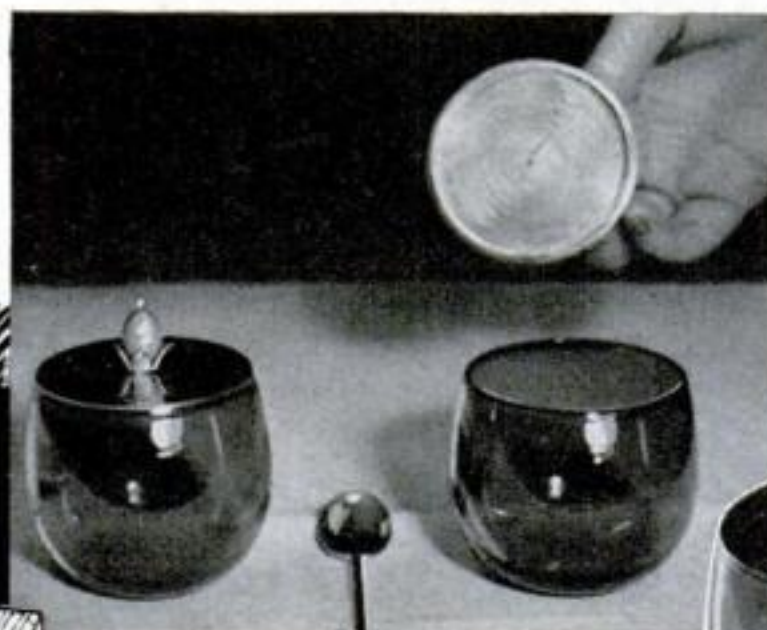
For the bent section of the shade, glue three layers of walnut veneer—sufficient for two panels $3\frac{1}{2}$ " by $9\frac{5}{8}$ ". The flat jig-sawed panels on both the shade and the base are $\frac{1}{8}$ " thick walnut, 8" in diameter for the shade and 5" for the base. Cut the designs in all with a 30- or 40-tooth blade to get a fairly smooth edge. Glue parchment or stencil paper to the base silhouettes and to the flat panels of the shade, but not to the veneer

panels. The base panels are held in the ring rabbets with $\frac{3}{8}$ " No. 0 brass screws.

In assembling the shade, fasten three stretchers $\frac{1}{4}$ " by $\frac{3}{4}$ " by 3" to the flat panels where indicated by the dotted lines, and sand the projecting corners until the stretchers are flush with the curve. Spread glue on the edges and on the underside of the jig-sawed veneer panels. Take a strip of parchment about 4" by 20", fold the end under the first stretcher, and tack temporarily; then pull it tight around the circumference of the shade and fasten to the third stretcher. Center the two veneer panels on stretcher No. 2 and nail in place. Bend the veneer down and clamp the ends to stretchers Nos. 1 and 3. Nail the veneer to the edge at $\frac{3}{4}$ " intervals with $\frac{3}{8}$ " No. 20 brads. Drill holes in the walnut if it is brittle. Nail the veneer to the stretchers.

Cut off the overhang of veneer and parchment and round the edges slightly with sandpaper. Cover the joint at the top with a piece $\frac{1}{8}$ " by $\frac{3}{4}$ " by $3\frac{1}{4}$ ". Finish the wood to match the turned parts. Attach a spring clip at the center of the top to hold the lamp shade.—EDWARD J. HOBERT.

Pewter Accessories Dress Up Ten-Cent Tumblers



The two small glasses above are intended for relishes. The larger one at right is a jam dish on a pewter plate

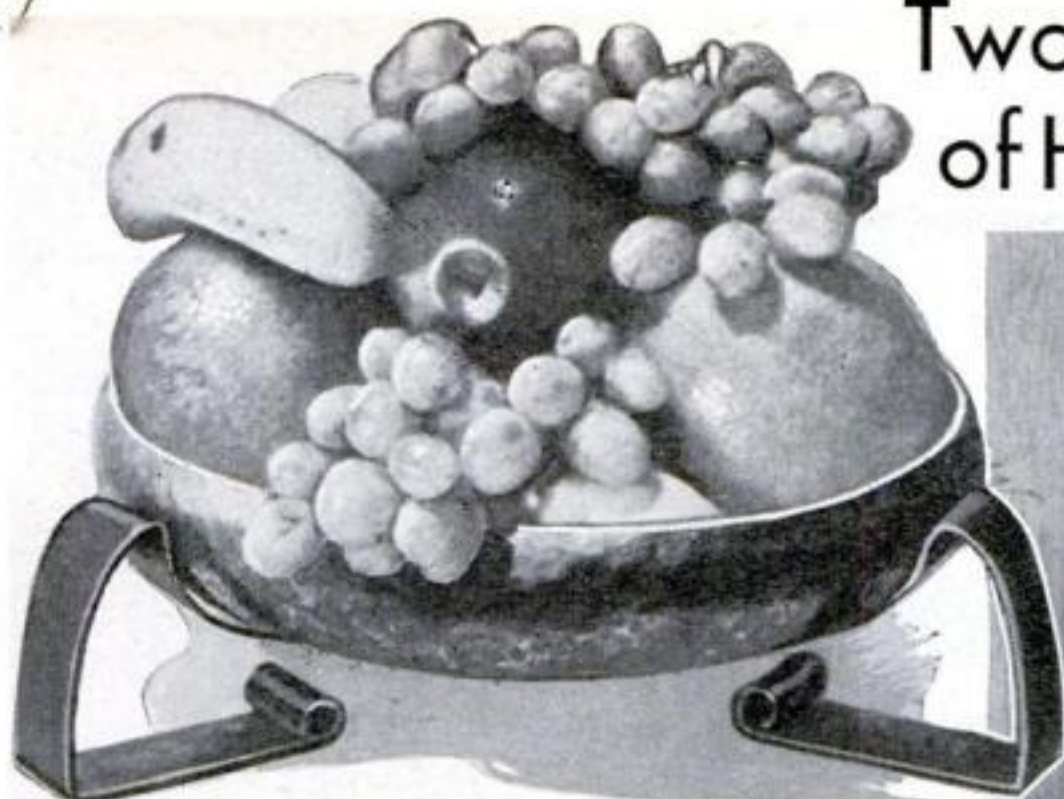
UNUSUAL and inexpensive table accessories can easily be made by adding decorative pewter tops to blue tumblers from the "five-and-ten." Eighteen-gauge pewter is cut into disks $\frac{1}{16}$ " larger than the top of the glasses. A strip $\frac{1}{8}$ " wide is then shaped to fit inside and soldered to the disk. Take care not to melt the pewter. Smooth the joint with emery cloth and polish all with 00 steel wool. Use blue beads for the knobs. Cut pewter as shown and shape to fit around the bead. The top finial is

made by melting a bit of pewter and thrusting a short length of 16-gauge copper wire into it. The wire is then threaded through the bead and the pewter. Bent down and soldered to the underside of the lid, it holds the knob firmly. The realistic strawberry knob on the larger jam dish is a dress button, also fastened by a copper wire threaded through its eye and soldered under the lid.

The plate is made from a 5" pewter disk and shaped on wooden forming molds with a rawhide mallet.—M. S. HOPKINS.



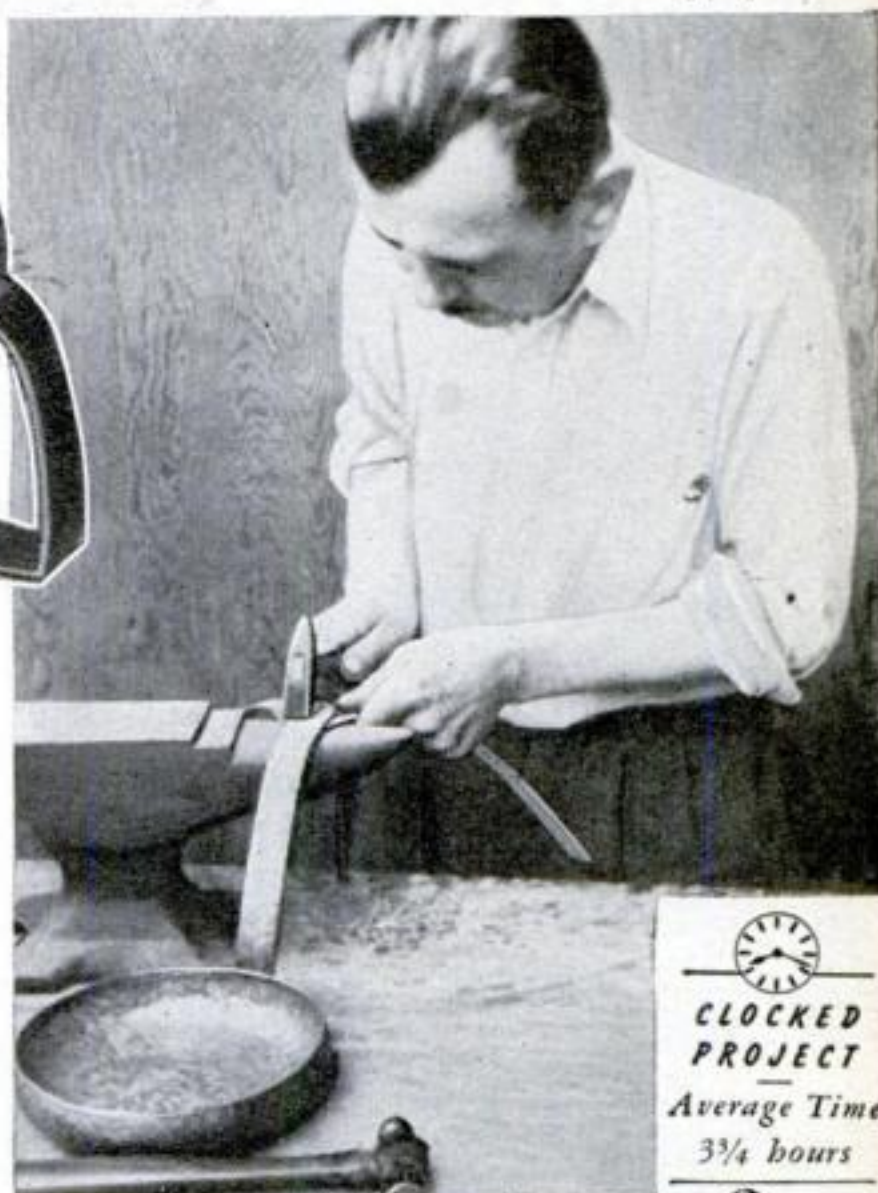
Two-Toned Fruit Bowl of Hammered Copper



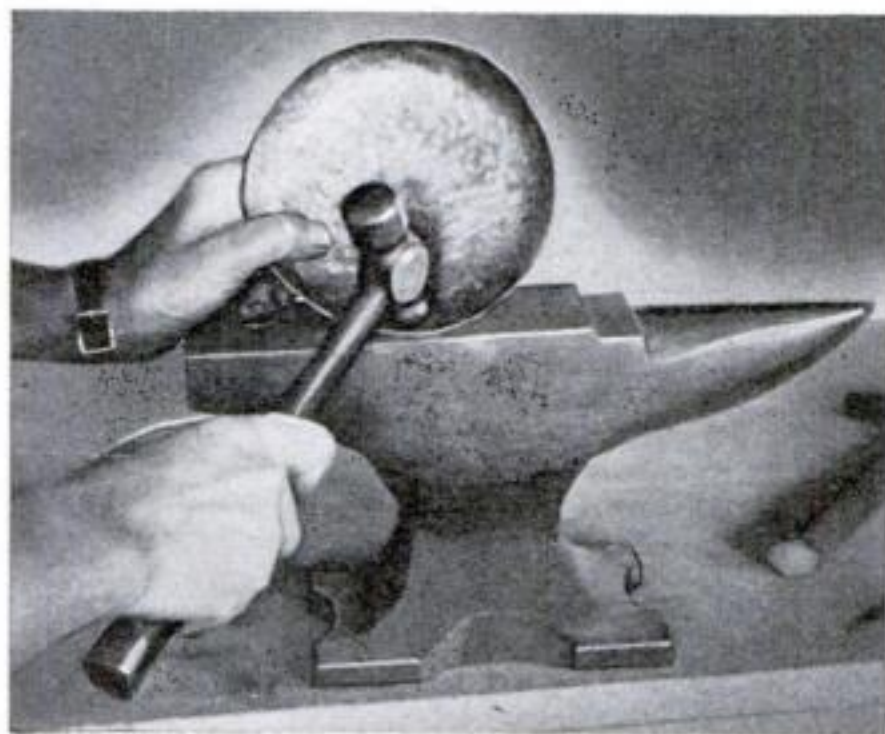
THE gleaming polish of this hand-hammered copper fruit bowl contrasts effectively with its black copper stand.

The bowl is made from an 8" diameter disk of 16-gauge soft sheet copper. It is raised to a depth of $1\frac{3}{4}$ " and, since hammering expands the metal considerably, it still measures about 8" in diameter when finished. Best results in raising the bowl can be obtained by holding it on the anvil at an angle, as illustrated below. When the bowl has been completed, clean the copper with commercial nitric acid and polish it well. Care should be exercised not to allow the acid to contact hands or clothing.

The stand is of 14-gauge copper. The parts are hammered, bent to shape, drilled, and riveted together. Coat the surface with liquid copper nitrate and heat until black. Dust off, then repeat. Finally, polish with floor wax.—DICK HUTCHINSON.



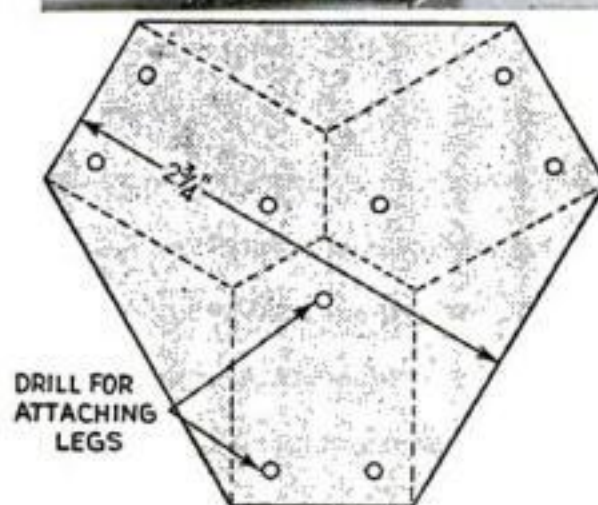

**CLOCKED
PROJECT**
Average Time
 $3\frac{3}{4}$ hours



The bowl is shaped by holding it at an angle on the anvil and hammering in concentric circles



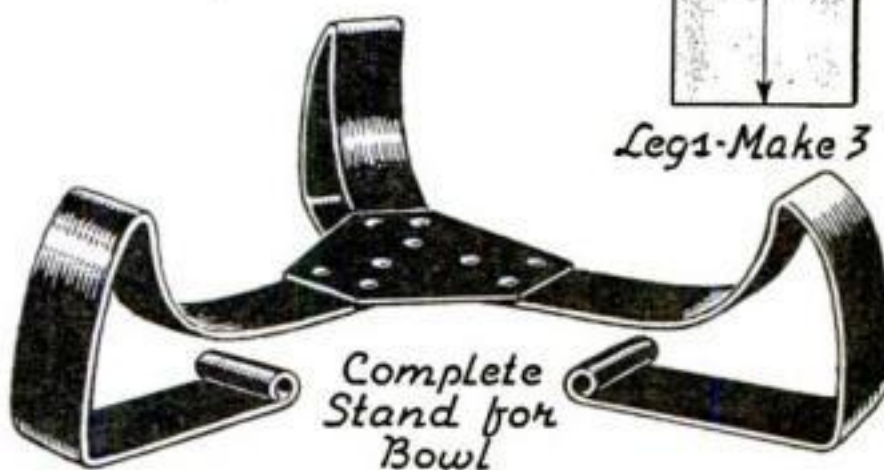
Cross Section of Bowl



Center Plate for Stand

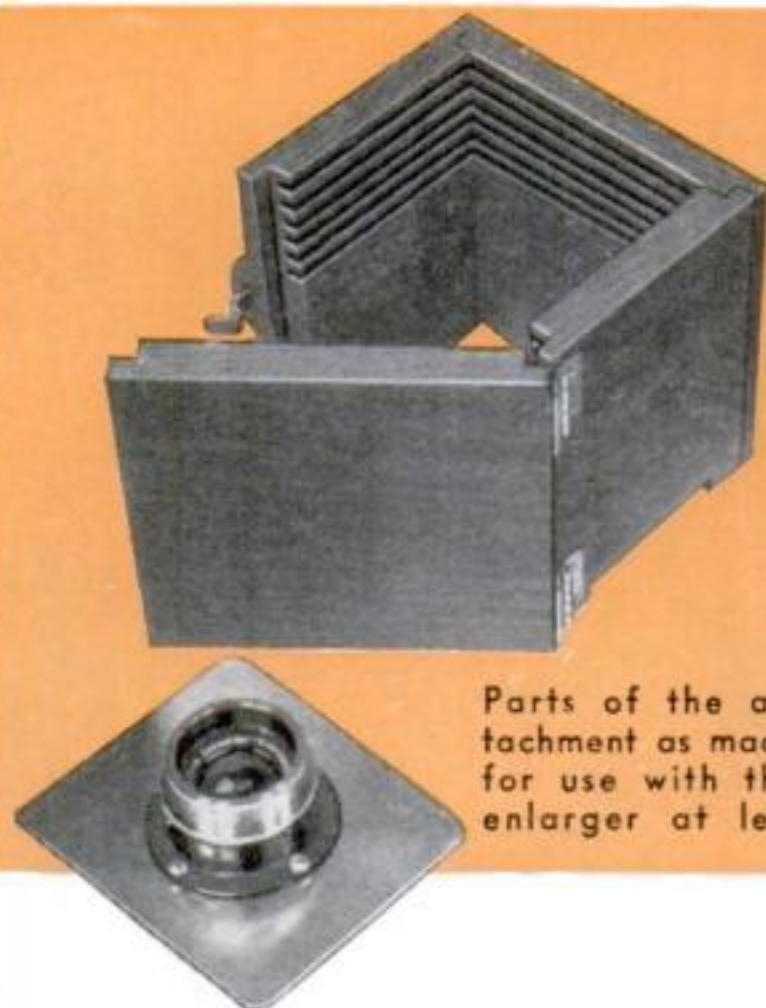
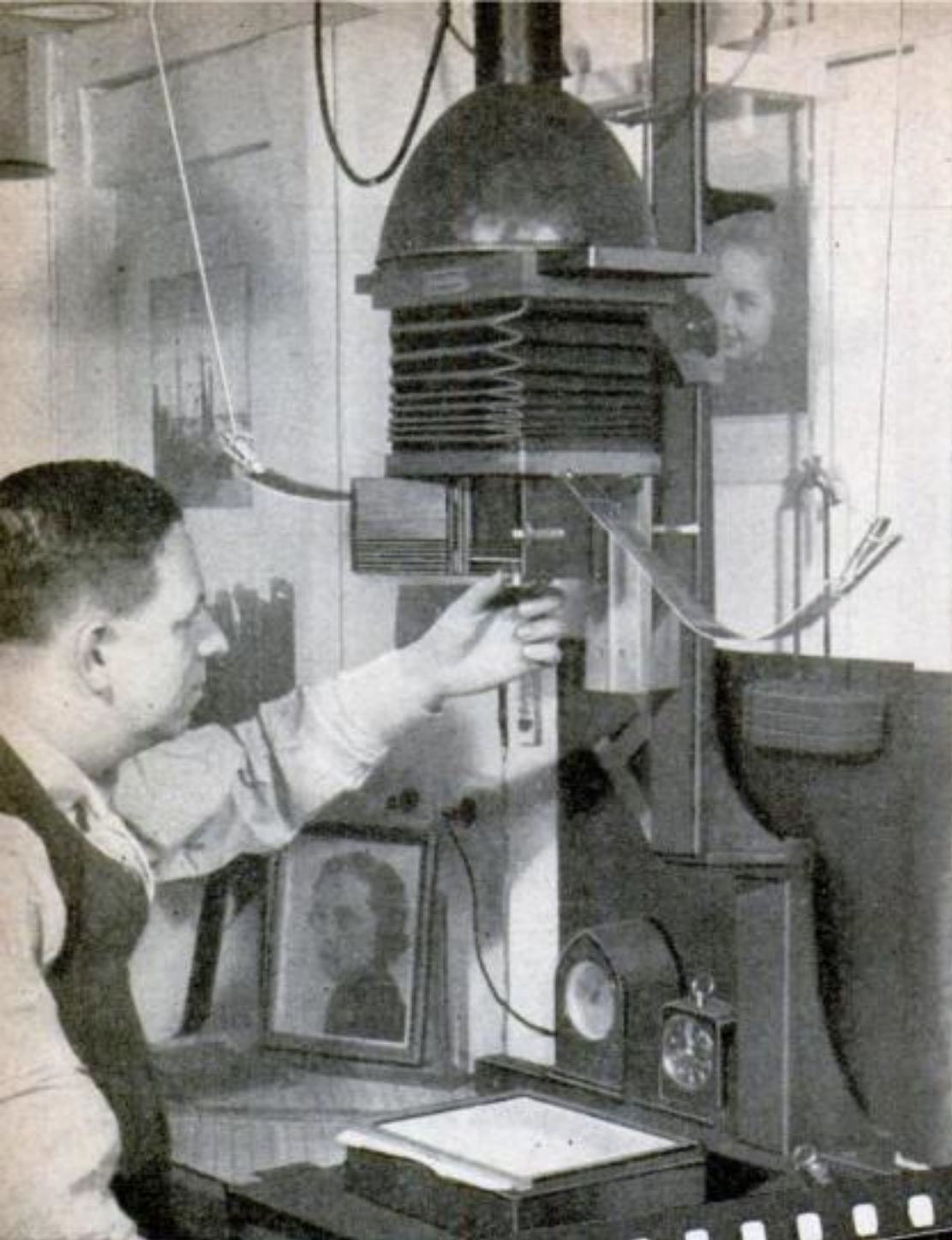


Leg 1—Make 3



Complete Stand for Bowl

The stand consists of three legs and a connecting piece. These are riveted as in the upper photo, then coated with liquid copper nitrate and heated to blacken the metal



Parts of the attachment as made for use with the enlarger at left

Miniature Enlarging

GETS RID OF ALL TROUBLE FROM DUST SPECKS

By
ALFRED P. LANE

DUST and Newton's rings cause more grief to the miniature-camera enthusiast who does his own enlarging than all other difficulties put together. Particles of dust seem to take a fiendish delight in getting on the negative, yet the more pains you take to get the negative and the contacting glass surfaces spotlessly clean, the greater the chance of trouble with colored rings caused by light interference, or Newton's rings. These show up in the enlargement in the form of mysterious blotches.

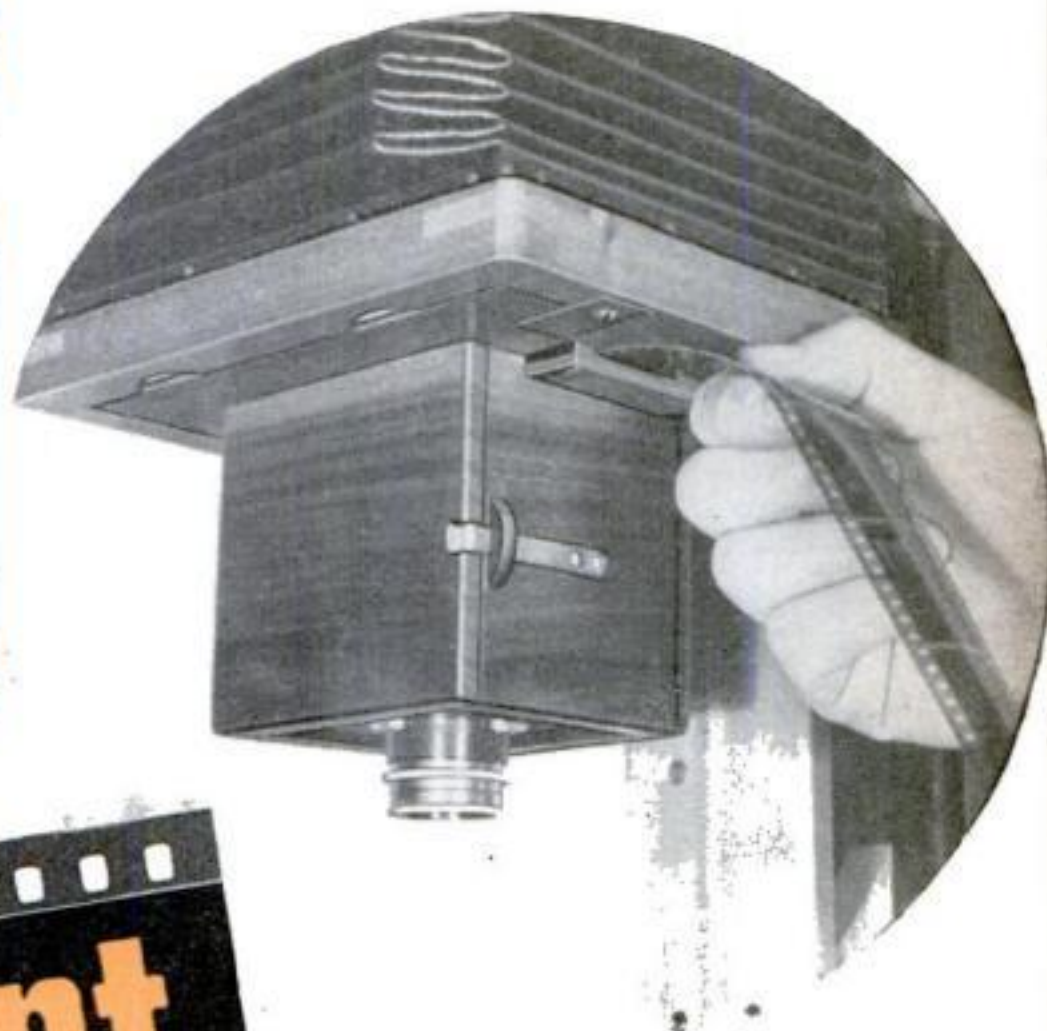
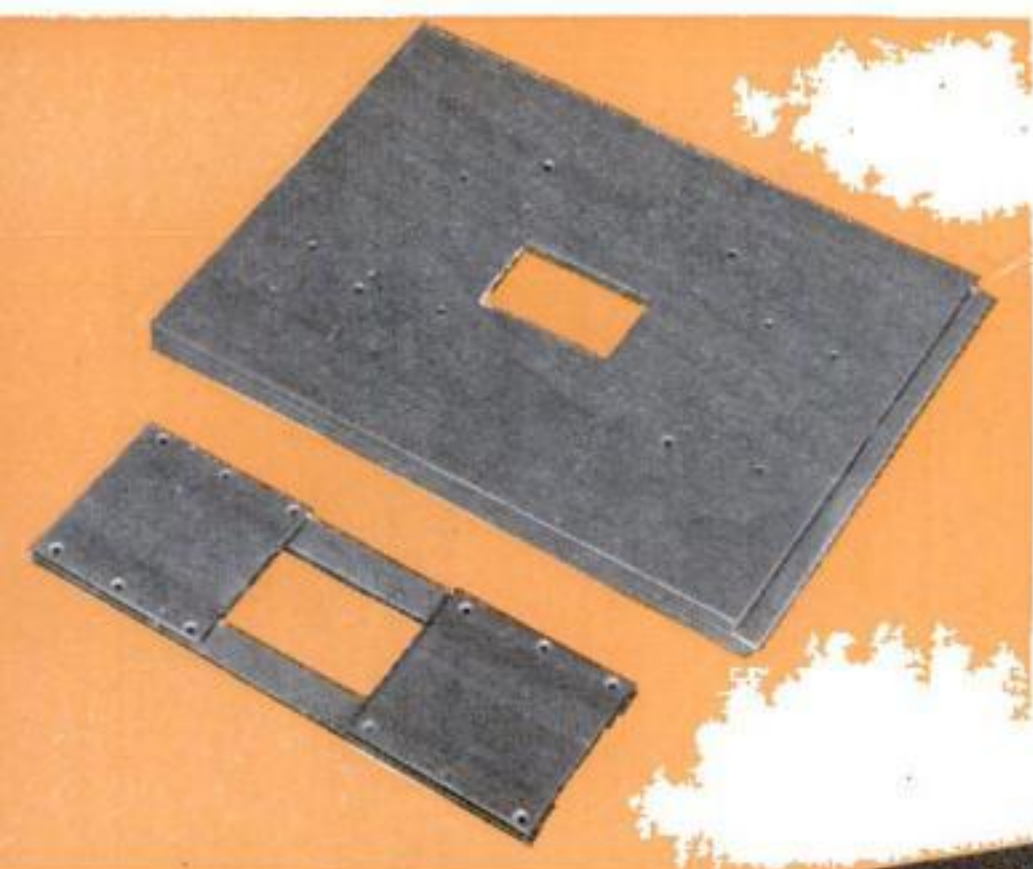
Both troubles can be avoided by using a miniature enlarging unit like the one shown. This was designed to work with any standard-size enlarger, but the same method of handling film can be applied to many types of strictly miniature enlargers.

The parts consist of a duplicate of the lens board of the enlarger, a film track

which is screwed to it, and a lens housing that holds the lens and provides a means of coarse adjustment for the focusing.

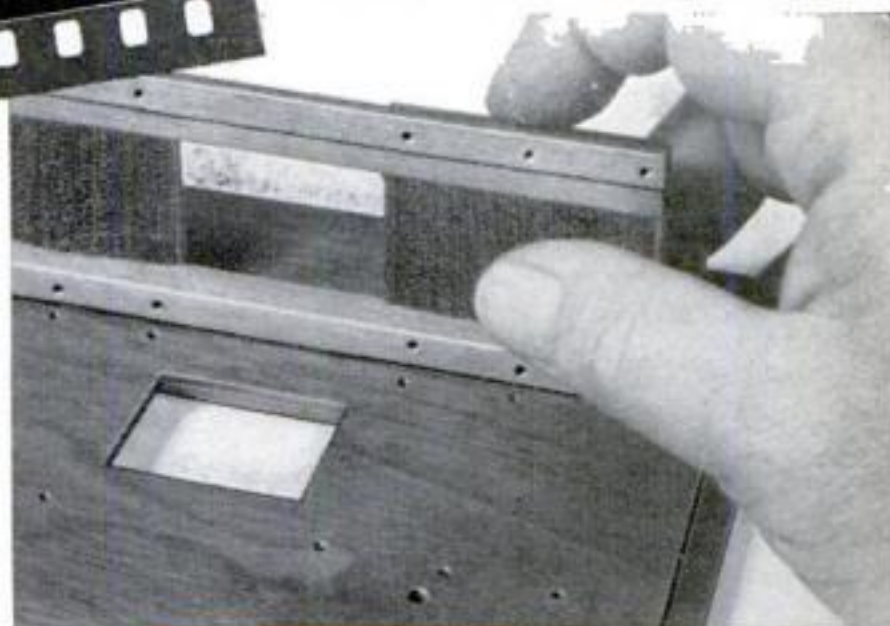
The film track requires two strips of wood (sawed in one long piece, of course, and then cut apart) with the face side sawed as shown to provide a groove or rabbet for the edge of the film. The tracks are screwed to two rectangular pieces. Velvet is cemented to these pieces at both ends, and smaller rectangular pieces of thin brass shim stock are located under the uncemented center portion of each pad. The brass pieces should have just enough spring to push the velvet against the emulsion surface with a very gentle pressure. In use, these velvet pads remove every speck of dust as the film is pushed through, and the absence of glass prevents any trouble with Newton's rings.

The sides and door of the lens box are cut from a long board after the grooves have been dadoed or sawn into it. This insures that the slots will match at the corners



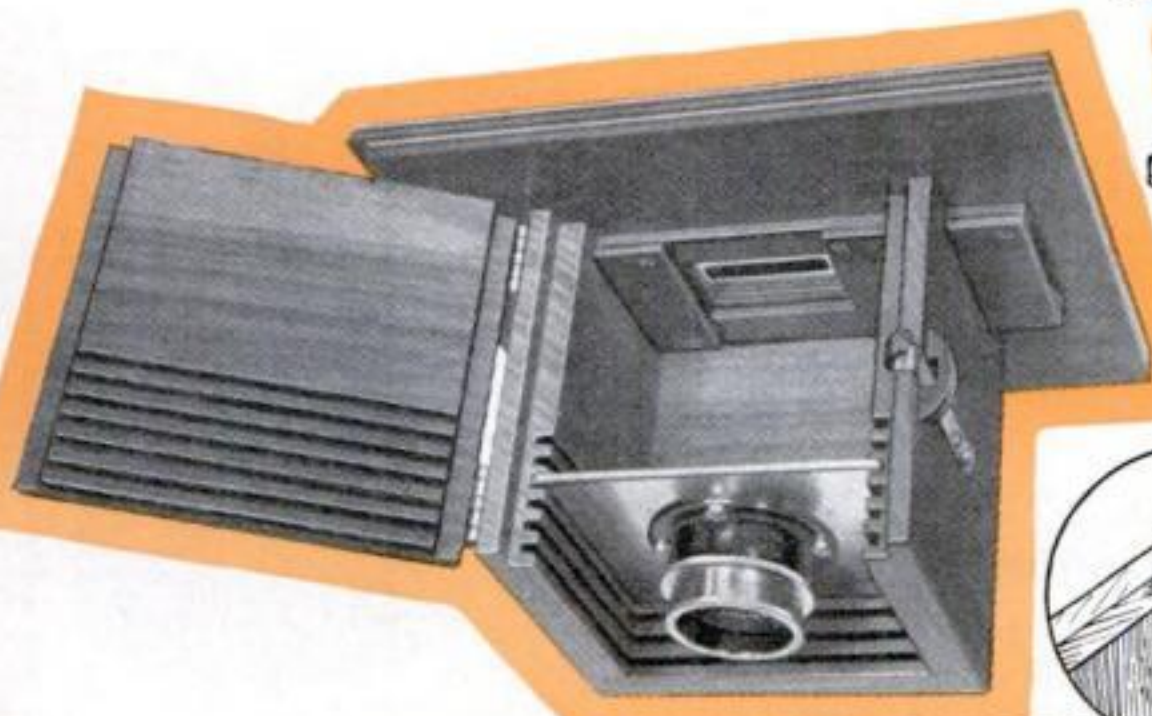
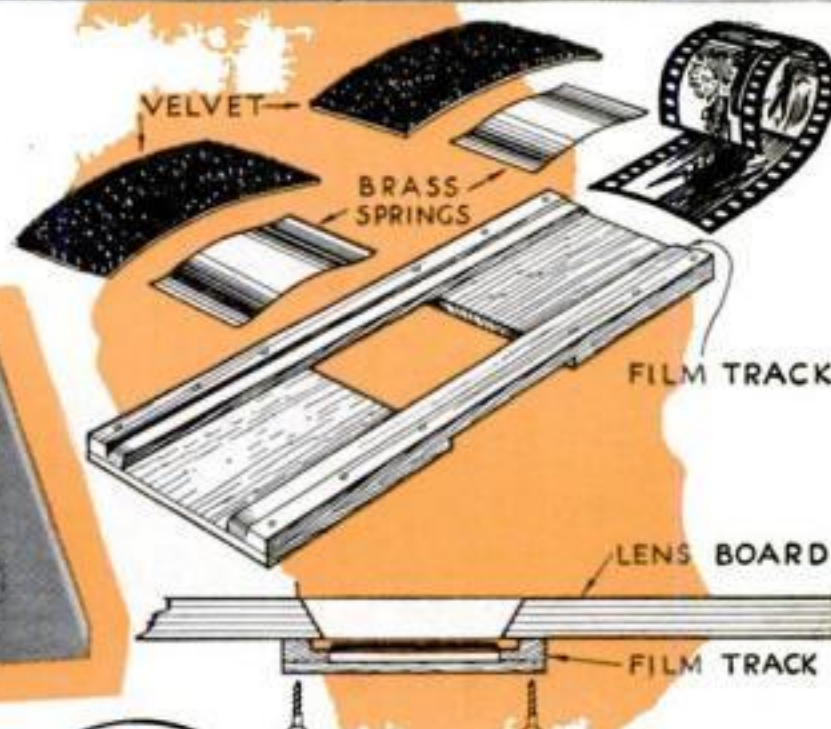
Attachment AND NEWTON'S RINGS

The film is pulled through a track fitted with velvet pads that automatically remove every dust speck



and that the lens axis will be perpendicular to the plane of the film. The grooves should be close enough together so that the distance the lens is moved by changing from one slot to the next will be slightly less than the maximum movement of the screw adjustment of the mounting. The interior of the box should be painted dead black.

Two wooden clothes clips will hold the loose ends of the film. Incidentally, a 35-mm. film loses its tendency to curl if left overnight wound into a roll, emulsion side out.



The **constructional details**. Use a piece of film to lay out the exact spacing of the film track. Other important dimensions depend upon the enlarger and lens

Rubber Band Guards Edge of Visual Filter

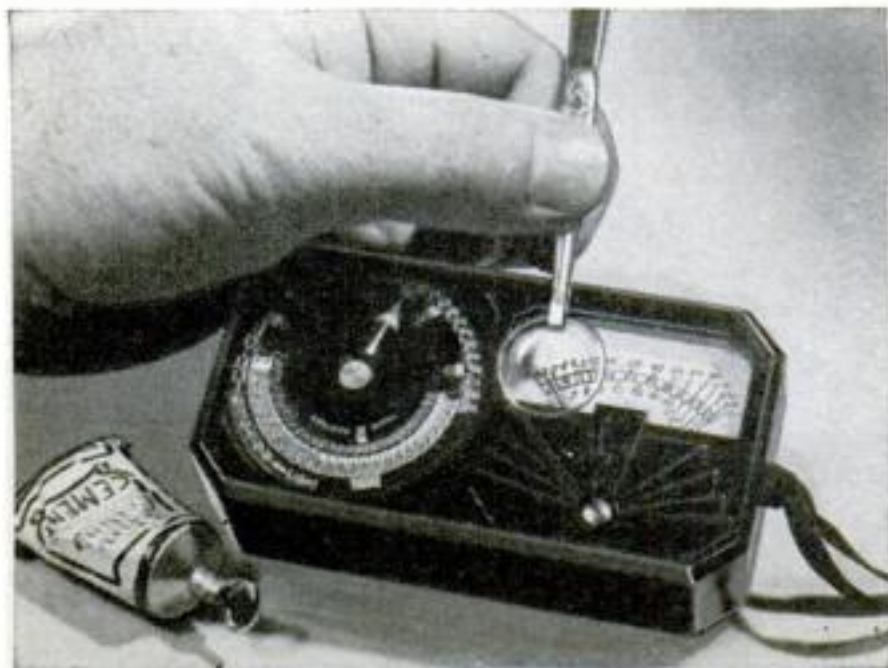
IF YOU carry a visual filter of the colored or monotone type for any length of time, the edge is likely to become chipped from knocking against hard objects. As a preventive, slip a fairly wide, short rubber band around the filter and cement it in place with shellac or rubber cement.—C. L.



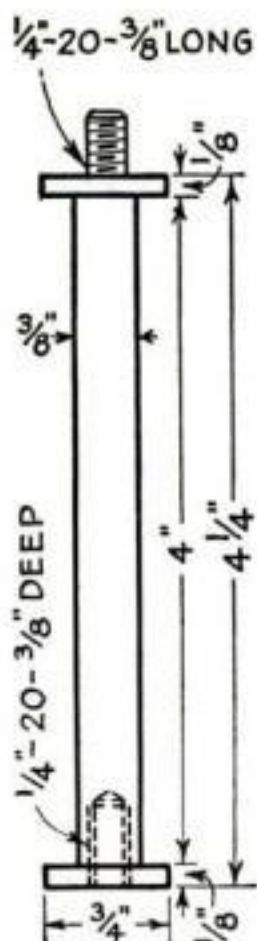
The edge is kept from chipping by a rubber band

Lens Aids in Reading Meter in Dim Light

WHEN you use a photo-electric exposure meter to judge dim light, the pointer rests in a crowded region of the scale where it is difficult to take an accurate reading. The dial can be read much more easily by obtaining a small plano-convex lens from an old camera view finder or other optical instrument and attaching it directly to the dial cover glass with cellulose cement or Canada balsam. The lens should not be so thick that it projects beyond the outside surface of the meter case.—EDWARD BURNHAM.



A small, discarded lens is cemented to the cover glass of the dial to magnify the crowded divisions



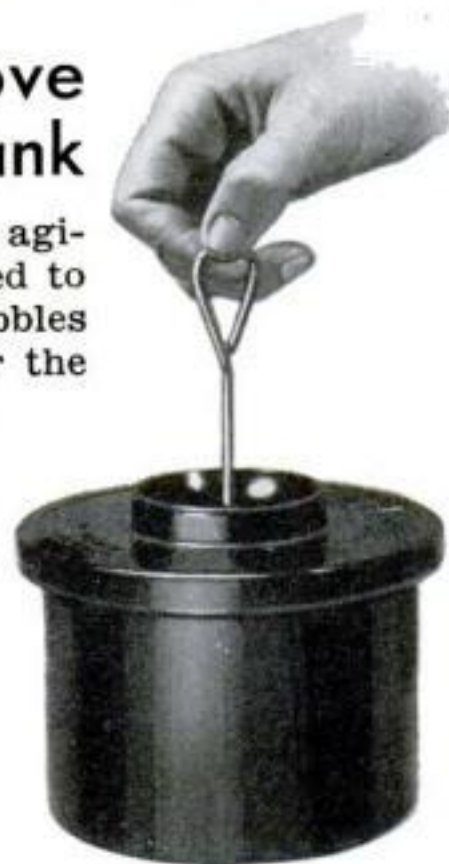
Tripod Extension Lets Camera Stay in Case

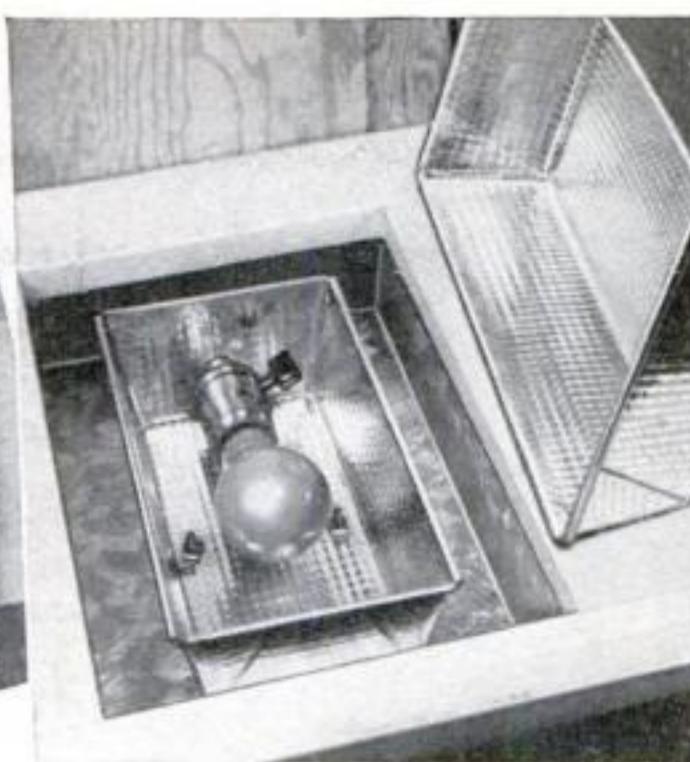
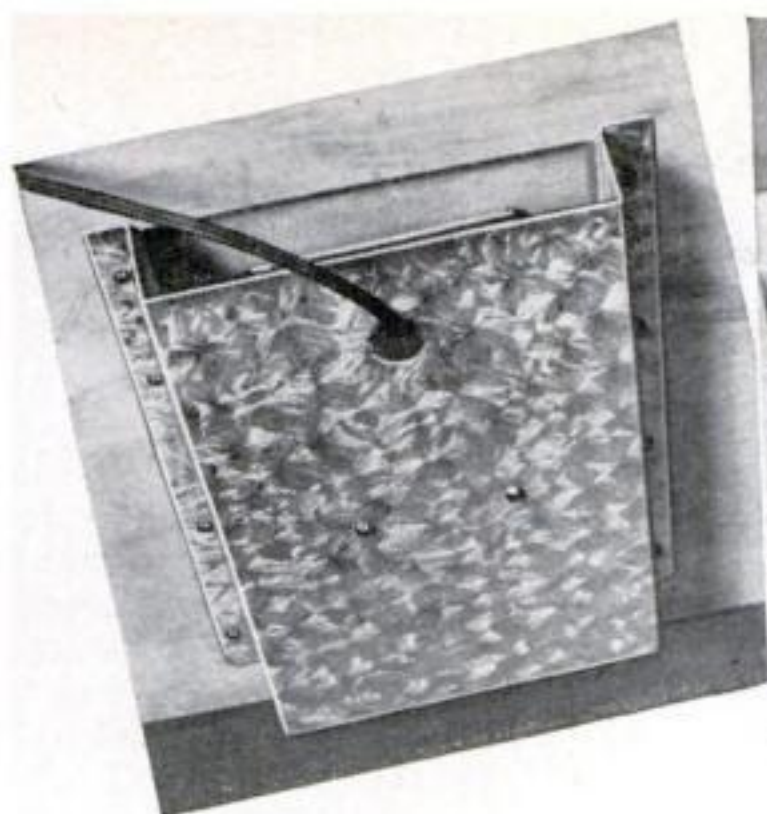
OUTDOORS, it is preferable to keep a miniature camera protected by the case even when a tripod is used. This is usually prevented however, by the short distance from the tilt top to the tripod head, as a result of which the leather flap cannot drop low enough to clear the lens.

The simplest remedy is to make a tripod extension as shown from a piece of $\frac{3}{4}$ " round brass rod 4" or 5" long. Turn down one end to $\frac{1}{4}$ " or to suit the depth of the tripod socket in the case. Thread this end $\frac{1}{4}$ "-20 to match the socket threads. The other end is drilled to a depth depending upon the length of the tilt-top thread, then tapped $\frac{1}{4}$ "-20. If desired, flanges may be turned as shown so that the diameter of the extension is reduced to $\frac{3}{8}$ ".—NATHAN SPERBER.

How to Remove Bubbles in Tank

MORE than ordinary agitation is often required to dislodge small air bubbles from a roll film after the tank is first filled with developer. The bubbles are best jarred free by inserting a nicked buttonhook into the tank and lifting the reel up and down sharply three or four times as necessary.—OLIVER BANDELIER.





Developing Tray Heater Made from Cake Tins

DEVELOPING solutions are kept at the proper temperature by this efficient heater. Two baking pans, one large enough to fit over the other, are recessed into a hole cut in the developing table or shelf. The bracket to which the smaller pan is bolted is cut to shape from galvanized sheet iron. The larger pan, upon which the developing tray rests, should fit flush with the top of the developing table when inverted over the smaller pan. The latter is fitted with a socket and a 20-watt bulb, and the wires are connected to a switch. It is wise to use a red bulb so that if the pan should be lifted inadvertently, no photographic paper will be damaged.—E. B. W.



Sunk flush with the top of the worktable or shelf, the heater consists of two cake tins inclosing a 20-watt bulb. Upper left, the supporting bracket

RETOUCHING PRINTS, PART 2

[PHOTOGRAPHY]

Water Color. Small cards, coated with black, white, and sepia, are available at photo supply shops and offer a convenient source of water colors for spotting prints. Use a spotting brush and dot the color on; do not attempt to "paint" the area. For work on glossy or ferrotyped prints, add a little mucilage to the water and experiment until the gloss of the color, when dry, matches that of the print.

Dry Spotting. Special carbon and photo-positive retouching pencils are quite satisfactory and may be obtained in several shades. Ordinary lead pencils leave too much sheen on most emulsions, but they may be used on some if the spotting is carefully rubbed in with the finger tip.

Glossy Prints. These are difficult to work on without leaving evidence of the retouching. Some workers claim, however, that coating the surface with negative retouching medium, spotting with a pencil, then re-soaking and ferrotyping will give excellent results.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

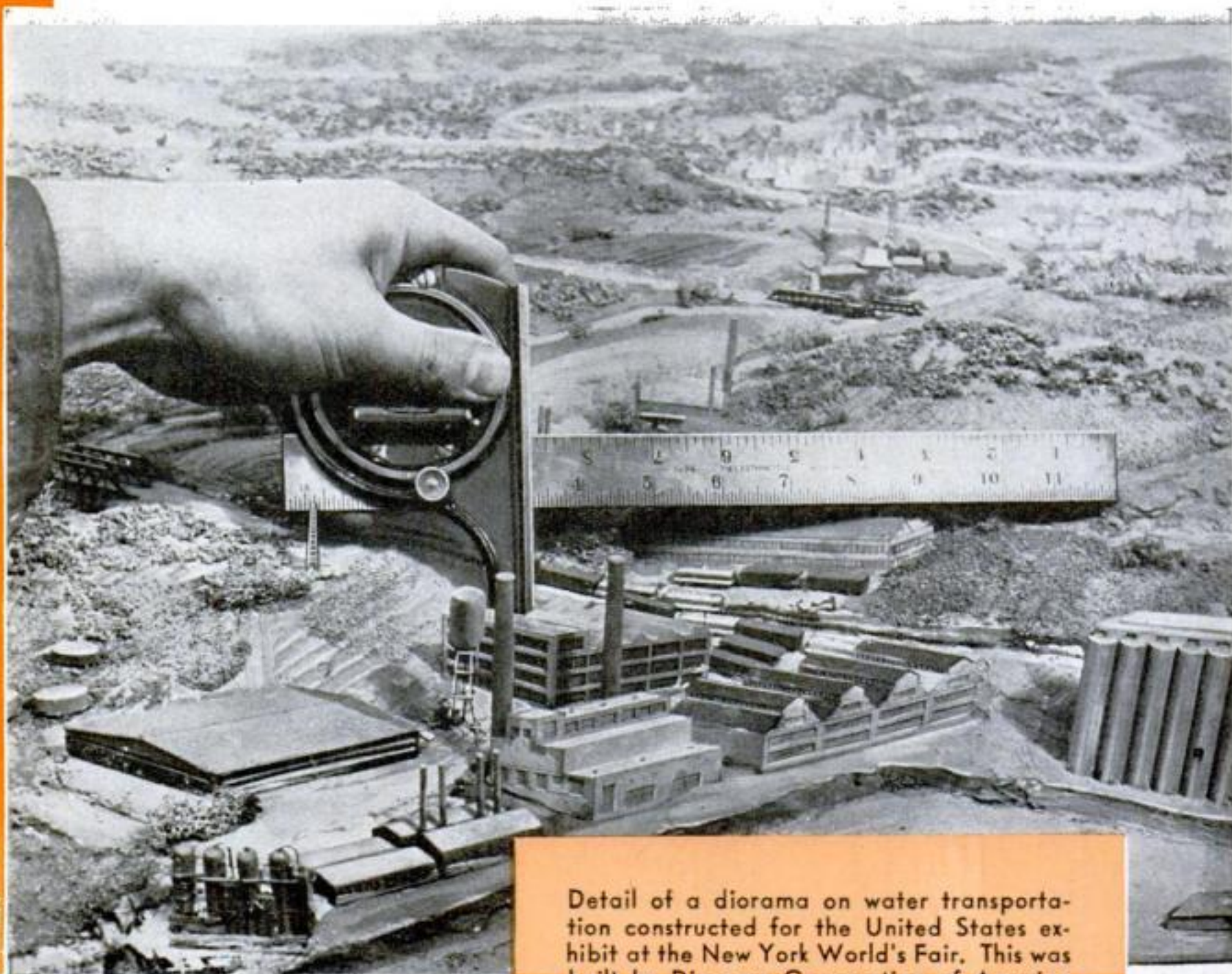
SCENES



Dioramas representing nearby scenes and close-ups are built in a box with sides, top, and bottom that slant inward, as shown on the opposite page

IF YOU were able to visit the New York World's Fair, you must have been impressed by the lavish use throughout the entire exhibition of large and small dioramas or miniature scenes. In almost every building these have been used to portray outstanding events, methods of manufacture, historic places, and all kinds of information in vivid, colorful, three-dimensional form.

Whether it was an old-fashioned stagecoach stopping before an inn, a modern Coast Guard vessel on patrol, a blast furnace in operation, a series of historical views like the "Forward March of America," or something as huge as the "City of Light" and "Railroads in Action," these scenes were startling in their reality. They were illuminated by hidden lights, and some even showed the same scene under various lighting effects, such as dawn



Detail of a diorama on water transportation constructed for the United States exhibit at the New York World's Fair. This was built by Diorama Corporation of America

IN MINIATURE

to dawn—all so beautifully done that you felt you were looking at a Lilliputian world.

These dioramas imitate life far better than any picture because there is depth to them. Their natural power to attract attention has made them extremely popular for window displays and advertising, and as permanent exhibits in museums, schools, and libraries.

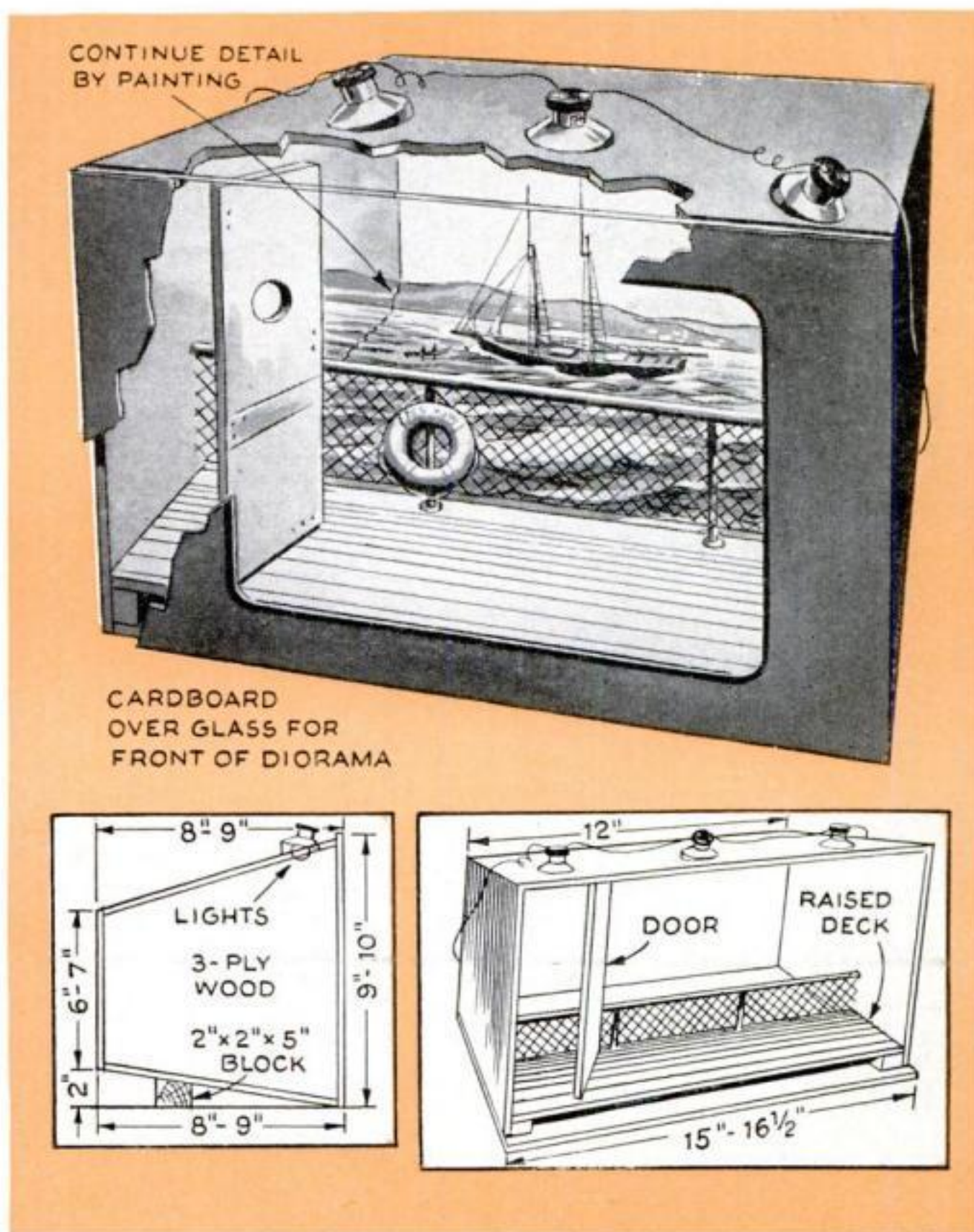
As you looked at them, you may have wondered whether you could build similar models on a small scale as ornaments or for advertising or educational purposes. You can. By using the methods shown in the accompanying illustrations, you will find it comparatively easy to duplicate scenes like those just mentioned, or others of your own choosing. Bear in mind, however, that the sketches and measurements are examples chosen to show the general principles of the art and are not intended to be copied in their entirety for

any one diorama. Details vary in each case.

You will notice that there are two kinds of dioramas, one with a square or flat background and the other with a curved background. The latter is used when the effect of distance or a far horizon is re-

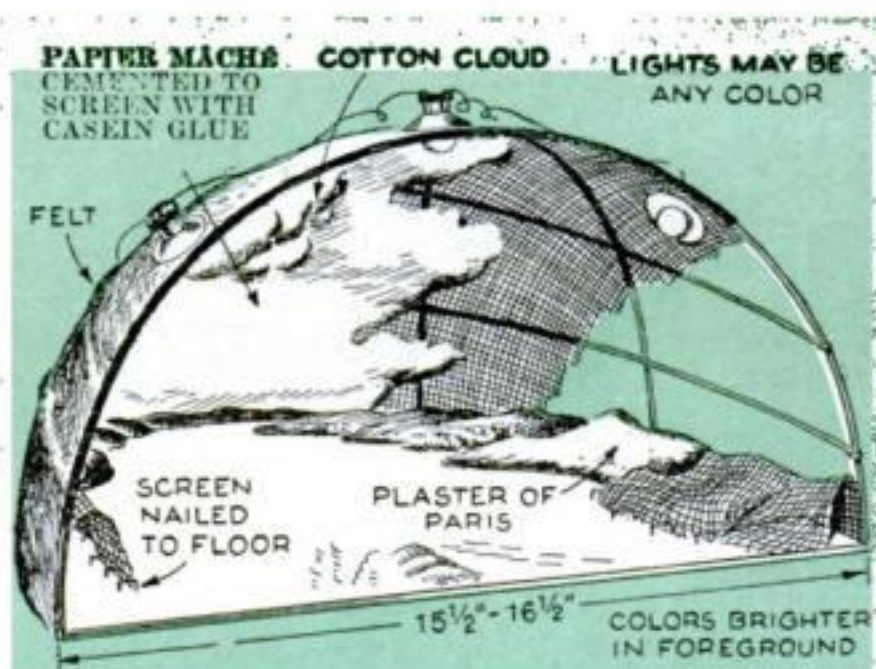
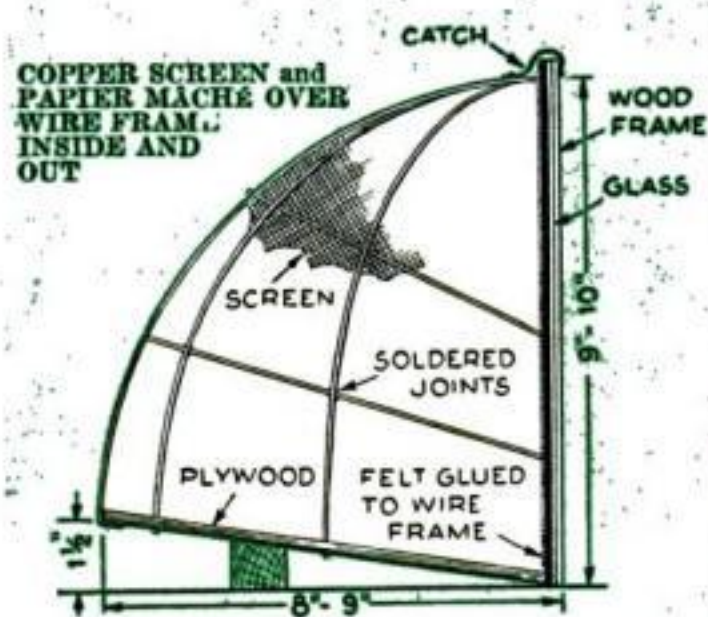
quired. The former is more appropriate for objects closer at hand.

After you have decided upon the subject of your first diorama—and it is suggested that you make the first one rather simple—begin with a baseboard or floor. It can be

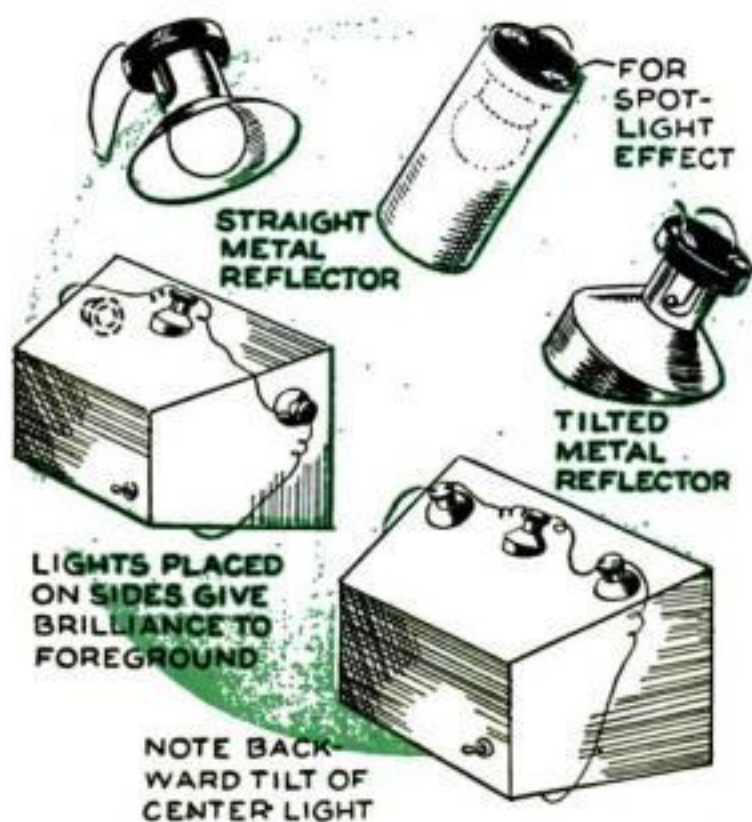


Hints on constructing small dioramas for home decorations, window displays, and advertising or educational purposes

By HERBERT LOZIER



Four stages in constructing a diorama with a curved background. This type

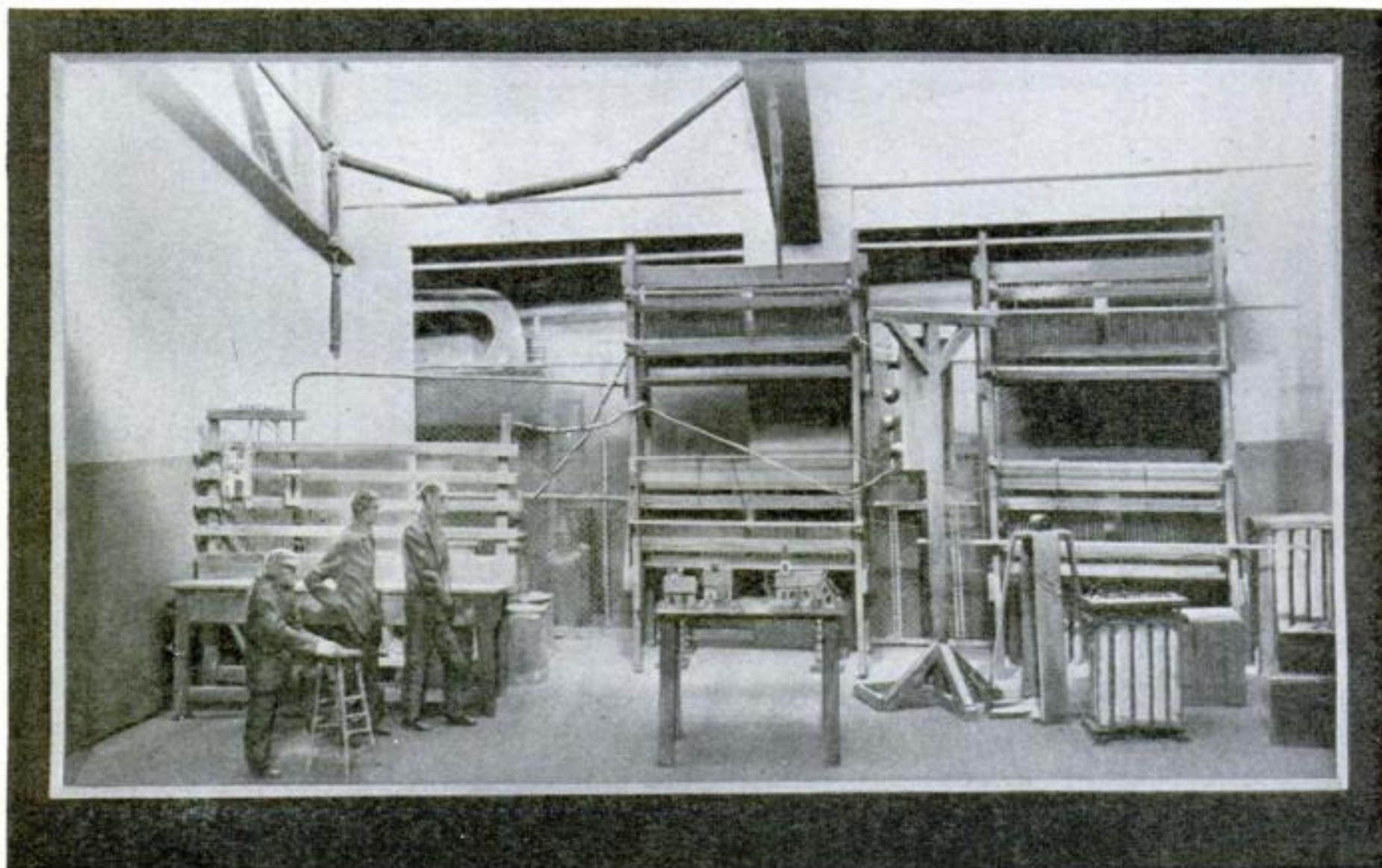


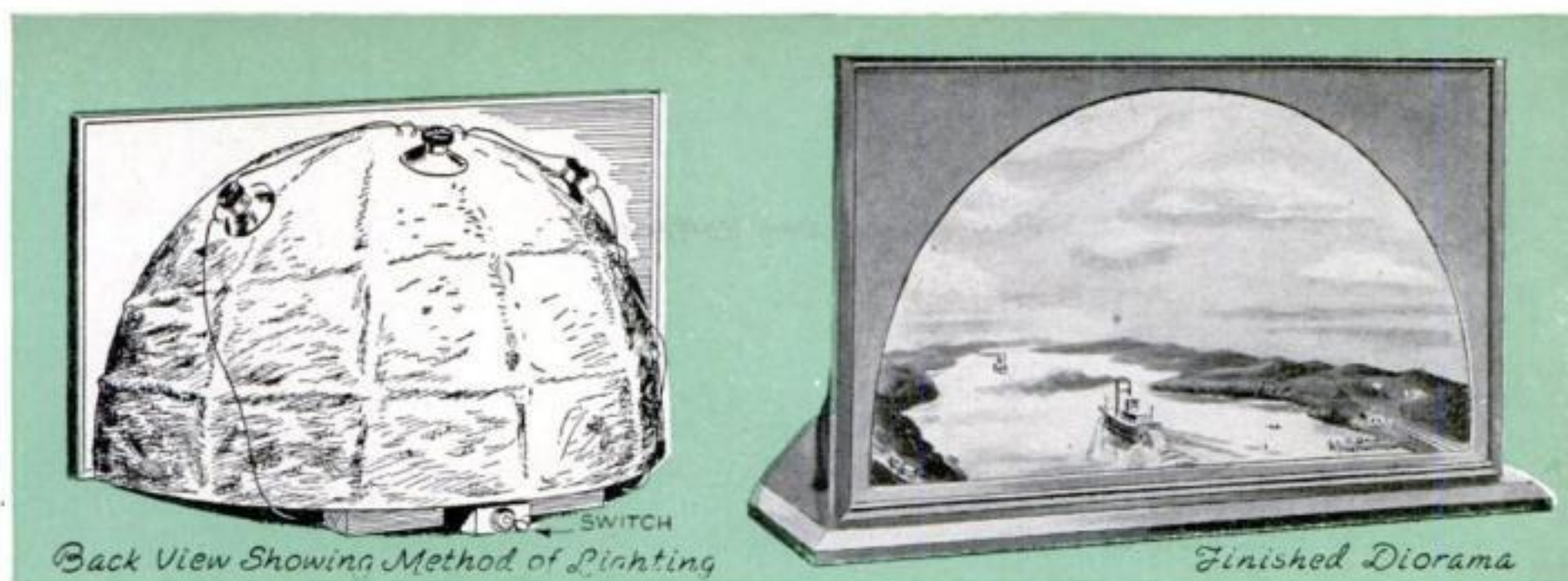
of thin three-ply wood. Cut it to shape, square or semicircular, as required by the subject you have chosen. If it is semicircular, drill the holes for the wire frame. In either case, a piece of wood must be beveled off and placed beneath the base as shown to give the desired incline.

Next, the background is put on the baseboard. It is either plywood, for the square type, or wire screen and *papier mâché* for the spherical type. Be careful to leave enough space for the frame of glass and wood. When this work has been completed, you may start to place the scenery and subjects inside.

It must be remembered that all the subjects making up the scene should appear to have depth. A feeling of distance must be obtained. The objects in the foreground are always larger than those in the background, and the colors closest to the eye are

"Charles P. Steinmetz in his Laboratory," 14" wide, 7" deep, 8" high. Also by Diorama Corporation





is used for outdoor scenes in which great distance or a far horizon must be shown

always the brightest. All subjects must be cut so they slope toward the rear to give the correct perspective.

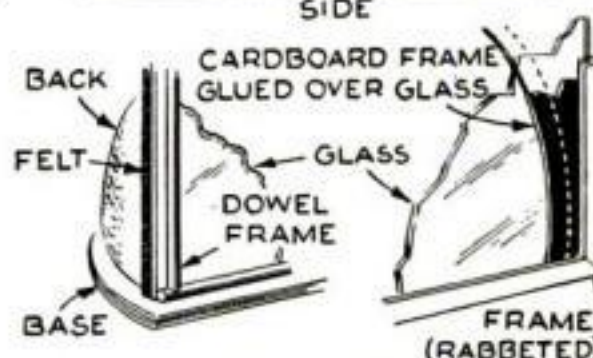
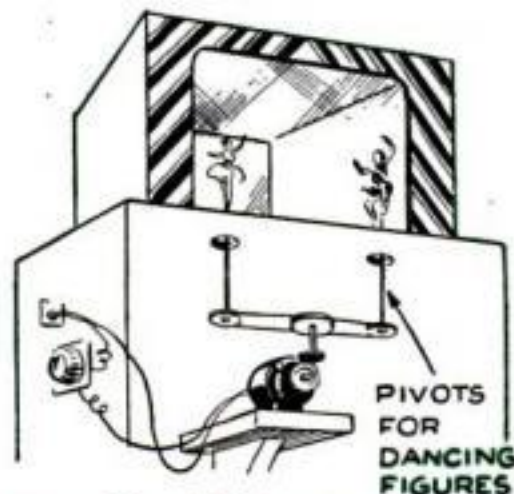
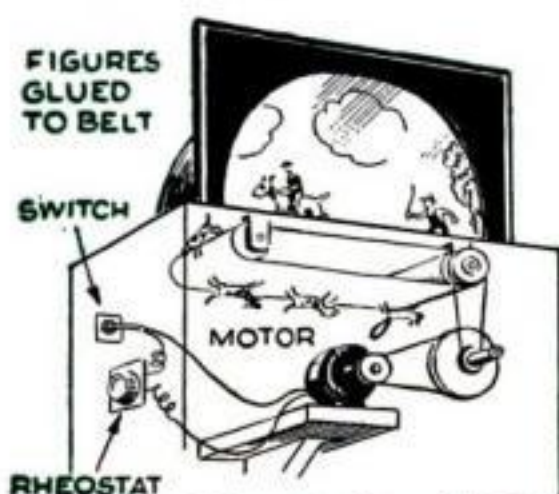
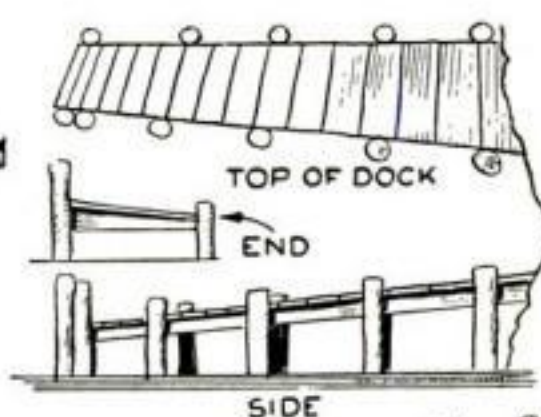
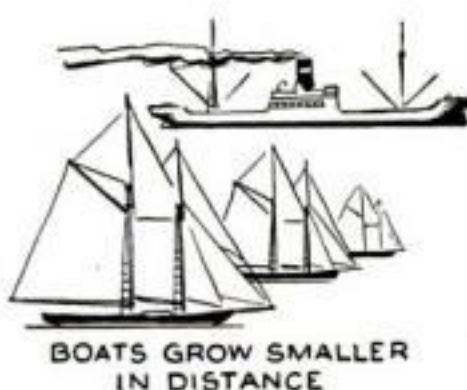
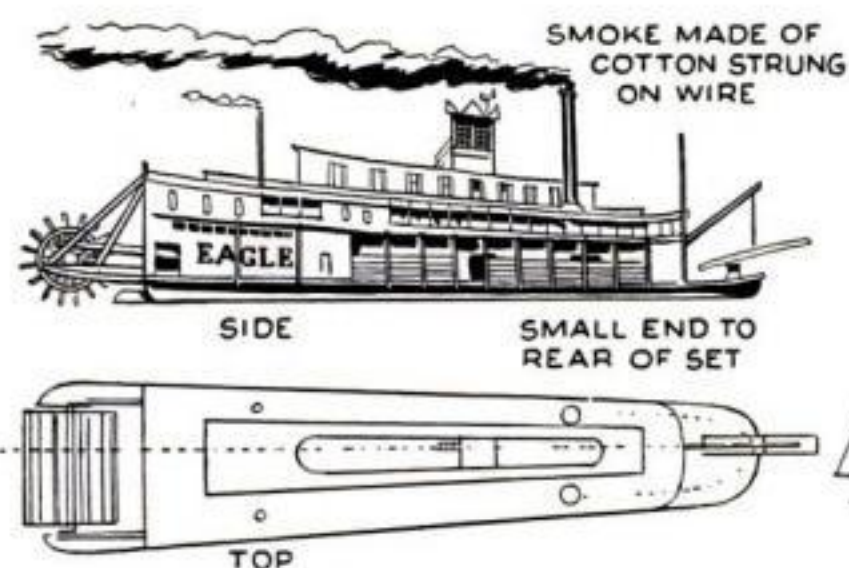
A few of the materials you can use are illustrated, but many other odds and ends will come in useful. Model airplane cement is suitable for all gluing purposes.

Ordinary plate glass, together with cardboard, wood, dowels, or strips of wood, form an excellent frame for the finished diorama. It's a good idea to place a length of felt between the glass and the set to prevent dust from getting in. The frame may be glued and nailed directly to the base, and the top may be left open to allow the glass front to be removed. Provide a secure fastening at the top.

The lighting is easily arranged. Ordinary Christmas-tree or radio pilot-light sockets may be used. Avoid, however, pointed Christmas-tree bulbs, which are likely to show below the frame. Various colored lights will give different effects and indicate the time of the day. It is even possible, with the use of a small motor and a suitable rheostat, to have the lighting change automatically.

Reflectors should be used with all lamps. The center lights should be tilted backward for best results, and the other lights set at any angle you wish.

Two methods of making the subjects move are also suggested in the drawings, but these, too, should be attempted only after considerable experience has been acquired in constructing dioramas.



Frames For Dioramas

SIZE OF OBJECTS AND INTENSITY OF COLORS DECREASE WITH THE DISTANCE FROM THE EYE

Two Methods For Animating Diorama

HOME-LABORATORY

SUCH simple apparatus as a reading glass, a concave shaving mirror, a short-focus magnifier known as a linen counter, and a fragment of a pocket mirror, enables a home experimenter to demonstrate optical principles of telescopes, microscopes, cameras, projectors, and magnifying glasses.

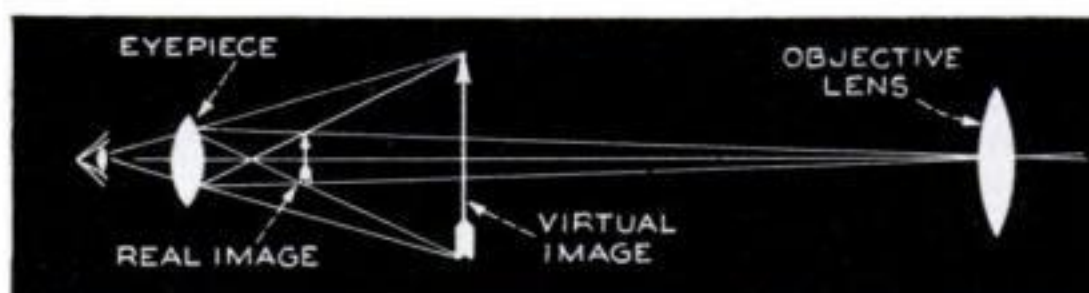
To locate the important "principal focus" of any lens or mirror, hold a white card at

the right distance—called the "focal length"—to form an image of a distant object.

Convex lenses and concave mirrors, alike, can be made to produce either "real" or "virtual" images. A real image can be caught on a screen like the ground glass of a camera. Virtual images are what you see through a magnifying glass, in a shaving mirror, or through the eyepieces of most telescopes and microscopes.



IN A refracting astronomical telescope, a long-focus lens produces an inverted real image and a short-focus lens is used like a magnifying glass to inspect the image. Your reading glass and short-focus magnifier, suitably mounted as at left, will make a similar experimental telescope. Its magnifying power equals the focal length of the reading glass, divided by that of the eyepiece. If the first is ten inches, and the second, one inch, the magnifying power will be ten times.



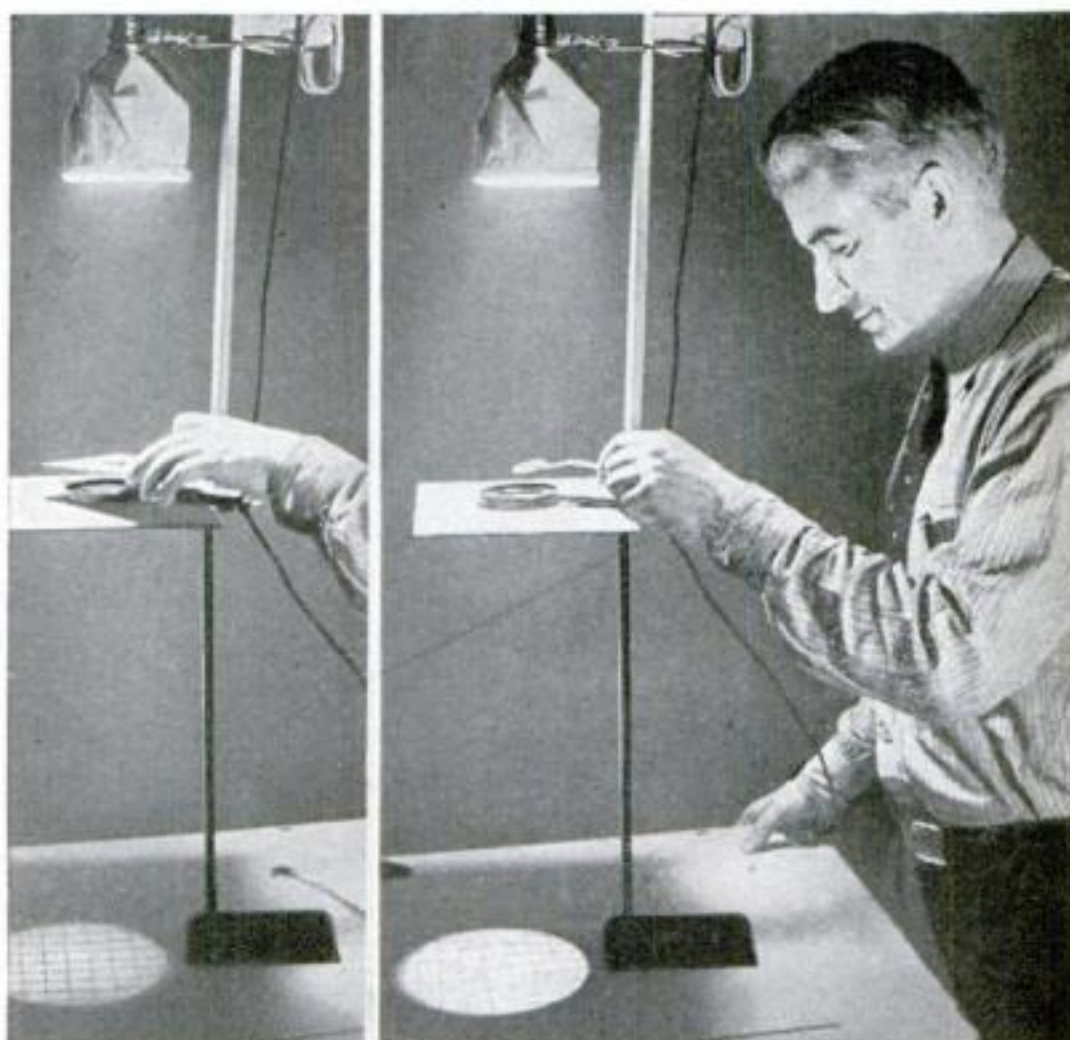
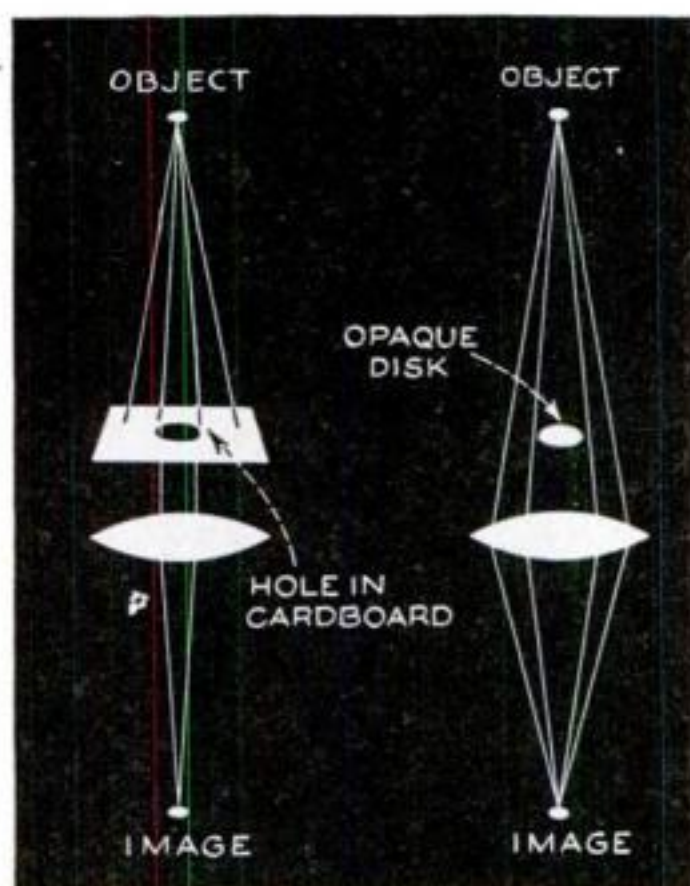
How two lenses are combined to form an experimental telescope

WITH the same two lenses that you used in the telescope described above, you can construct a compound microscope. This time, however, the lens of shorter focal length serves as the objective, or lens nearest the object to be viewed. By placing this lens above the object at a distance just beyond its principal focal length, a greatly magnified real image is obtained. The eyepiece is brought a little nearer than its focal length to this image, giving a virtual image enlarged still further. Note that, as with the telescope, the virtual image is the apparent but not the real source of light rays reaching the eye. The accompanying drawing shows how the lenses are placed and paths of light rays.



By reversing positions of the lenses, you get a working model of a compound microscope

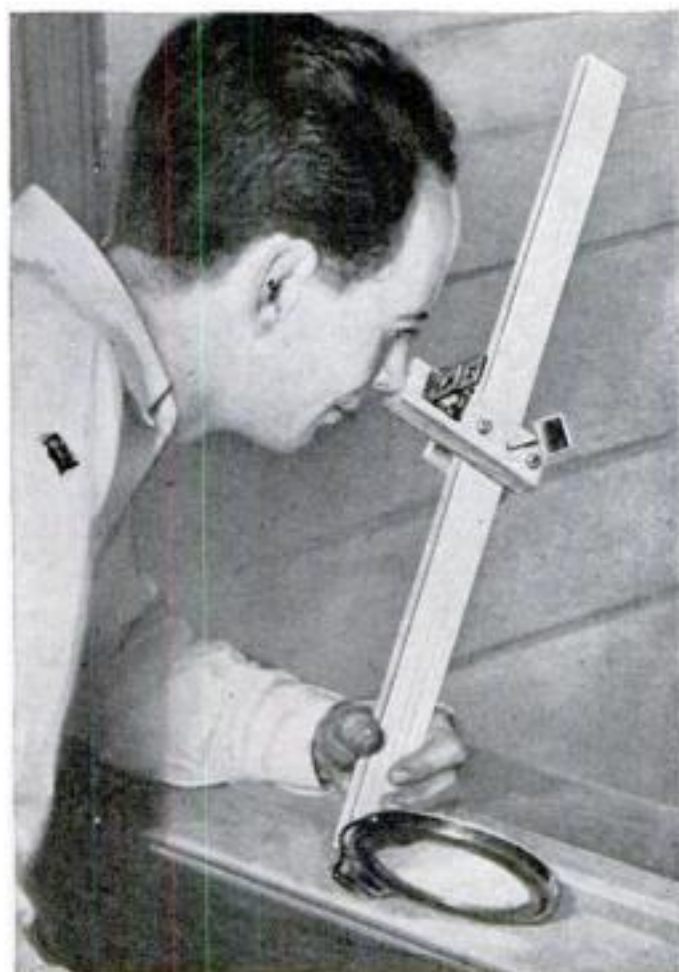
TESTS WITH LIGHT



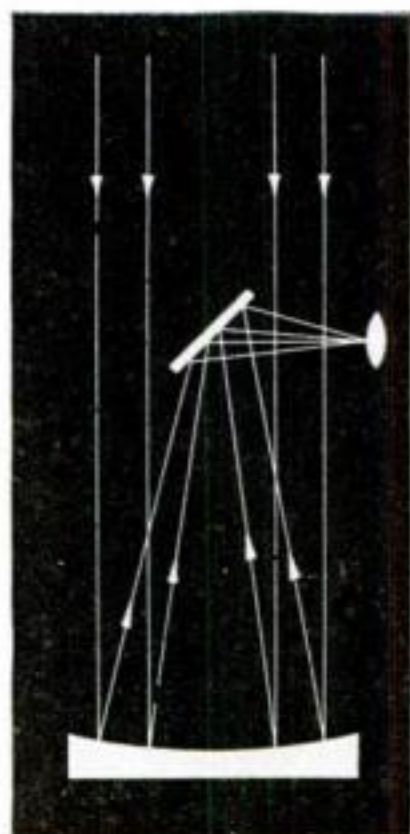
WHY isn't a circular shadow thrown on a picture, when you "stop down" or narrow the aperture of a camera lens? With the illustrated set-up, try covering a lens with a piece of cardboard in which a smaller hole is cut. The image is merely dimmed. Now try covering only the center of the lens, with an opaque disk. The result will be the same. Rays of light entering every

A cardboard ring or disk held over a lens does not cut off any of the image, but merely dims it. Drawings explain why

part of the lens go to every part of the image, and either the central or outer rays may be brought to a focus by themselves, although they usually overlap. An example below shows an interesting application of this principle in astronomical telescopes.



Model of a reflecting astronomical telescope, using a concave shaving mirror, small flat mirror, and lens



REFLECTING telescopes of great astronomical observatories often have a secondary mirror interposed between the big concave mirror and the sky. The smaller mirror directs the image to an observer's eyepiece, outside the telescope. Why it doesn't obstruct the central part of the image has just been explained by the previous experiment. To make a model telescope of this kind, arrange a concave mirror, a small flat mirror, and a short-focus magnifying glass as illustrated. For viewing distant objects, the eyepiece should be near the principal focus of the shaving mirror. The eyepiece acts as a magnifying glass, giving an enlarged virtual image of the image produced by the mirror. Any distortion of the image will be due largely to the imperfect surface of the mirror. Ordinary concave mirrors are ground to a circular, rather than a parabolic curve.

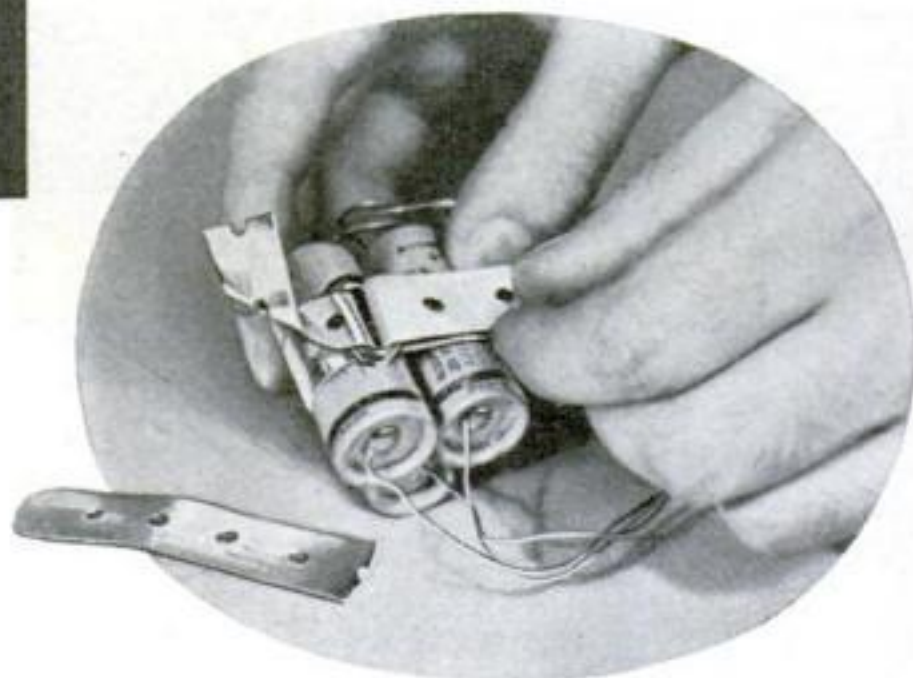
DEVELOPMENTS IN



A close-up of the new electric-eye phonograph in use

Phonograph Pick-Up Uses Electric Eye

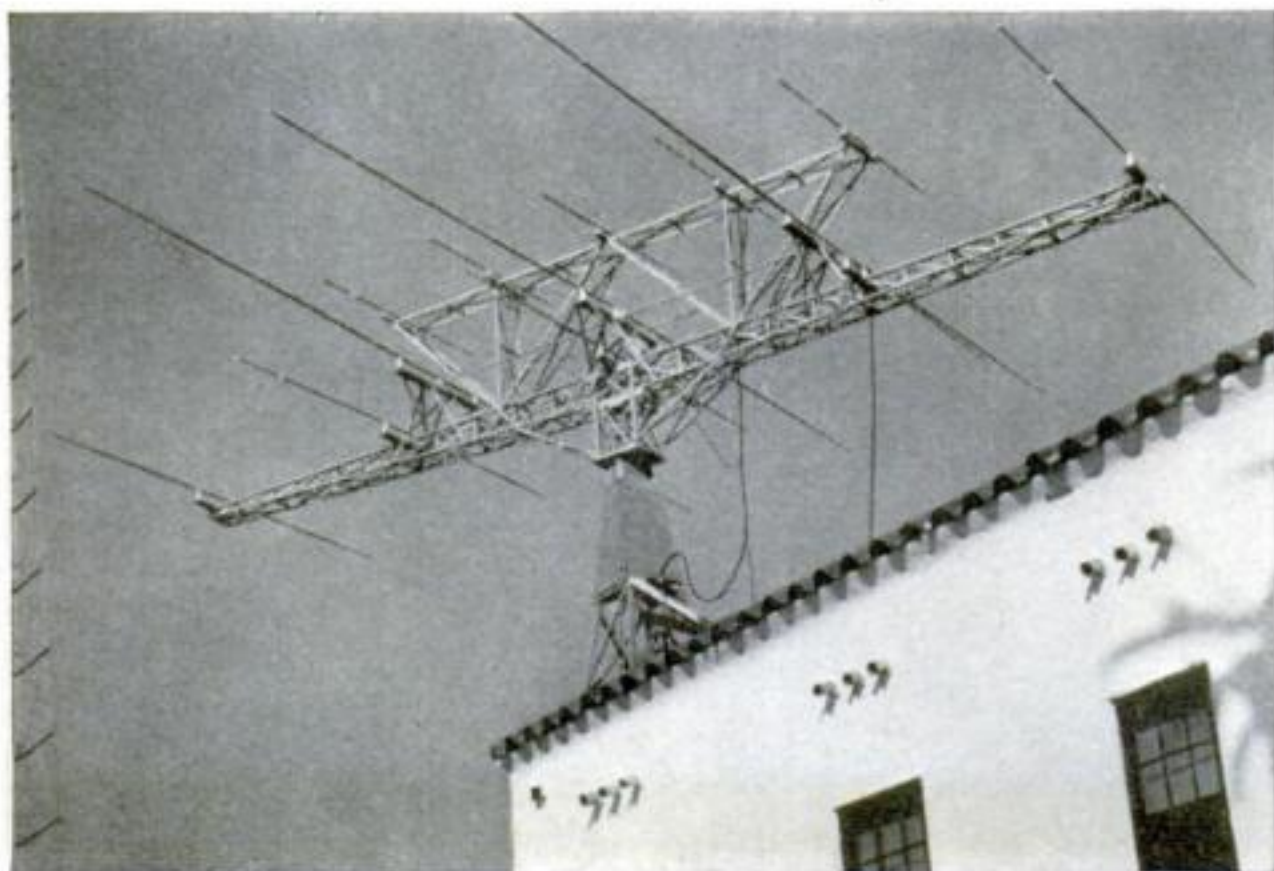
BETTER reproduction of phonograph records is claimed for a pick-up recently introduced by a nationally known radio manufacturer. On the pick-up arm, a tiny rounded jewel replaces the conventional needle to follow the record groove. Attached to the jewel is a small mirror which vibrates with the jewel and in turn reflects a beam of light against an "electric eye." The eye, or photo-electric cell, then translates the vibrations of the light beam into electric impulses in the amplifying circuit to reproduce the music or other sound of the recording.



How the strap binds several condensers into one unit

Strap Binds Condensers

VARIOUS combinations of small-size tubular electrolytic condensers can be combined into a single installation unit for easy mounting with the handy metal straps shown in the illustration at the right. Flexible, and soft enough to be cut with scissors, the straps are locked with a metal eyelet.



Three rooftop antennas in a single assembly that weighs only 187 pounds

Amateur Builds Triple Antenna for Transmitter

THE novel three-layer, "composite" transmitter antenna atop the home of W4EDD, a Coral Gables, Fla., amateur, weighs only 187 pounds. The top section is a five-element, quarter-wave affair for 56 megacycles. The bottom is a similar type for 28 megacycles, while in the center is a three-element, closed-spaced array for 14 megacycles.

THE RADIO WORLD



Radio Chemical Kit Aids Repair Men

CONTAINING eight bottles of different chemicals useful to the radio-service man, the compact kit shown in the illustration above is a valuable accessory on repair jobs. Cement, polish, oiling compounds, carbon remover, and similar products are among the materials.

Inexpensive Switch-coil Outfit

REMARKABLY inexpensive, an outfit with which amateurs can make their own five-coil, single-switch units to replace plug-in tuning coils is now available. Coil forms, spacers, the various switch parts, and a bottle of special lacquer cement are included in the kit. Additional switch wafers and coil forms are furnished by the manufacturers at moderate cost.



With these parts, it is easy to build a compact switch-coil set

Coat-Pocket Portable Set

FOUR tubes are used in the circuit of a tiny new battery-powered, loudspeaker radio just announced. As shown in the illustration at the right, the midget set is so small that it is readily carried in a side pocket of a man's suit coat.

The tiny set fits in a pocket. Batteries run it for 100 hours without replacement

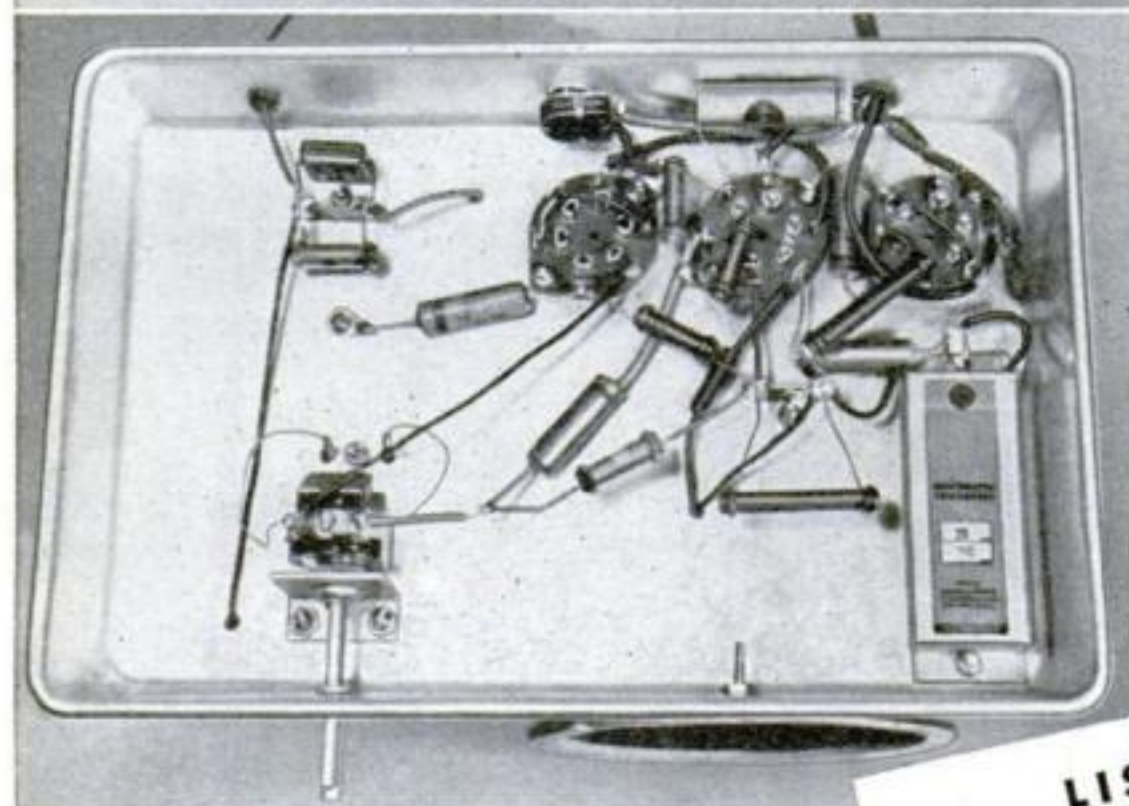
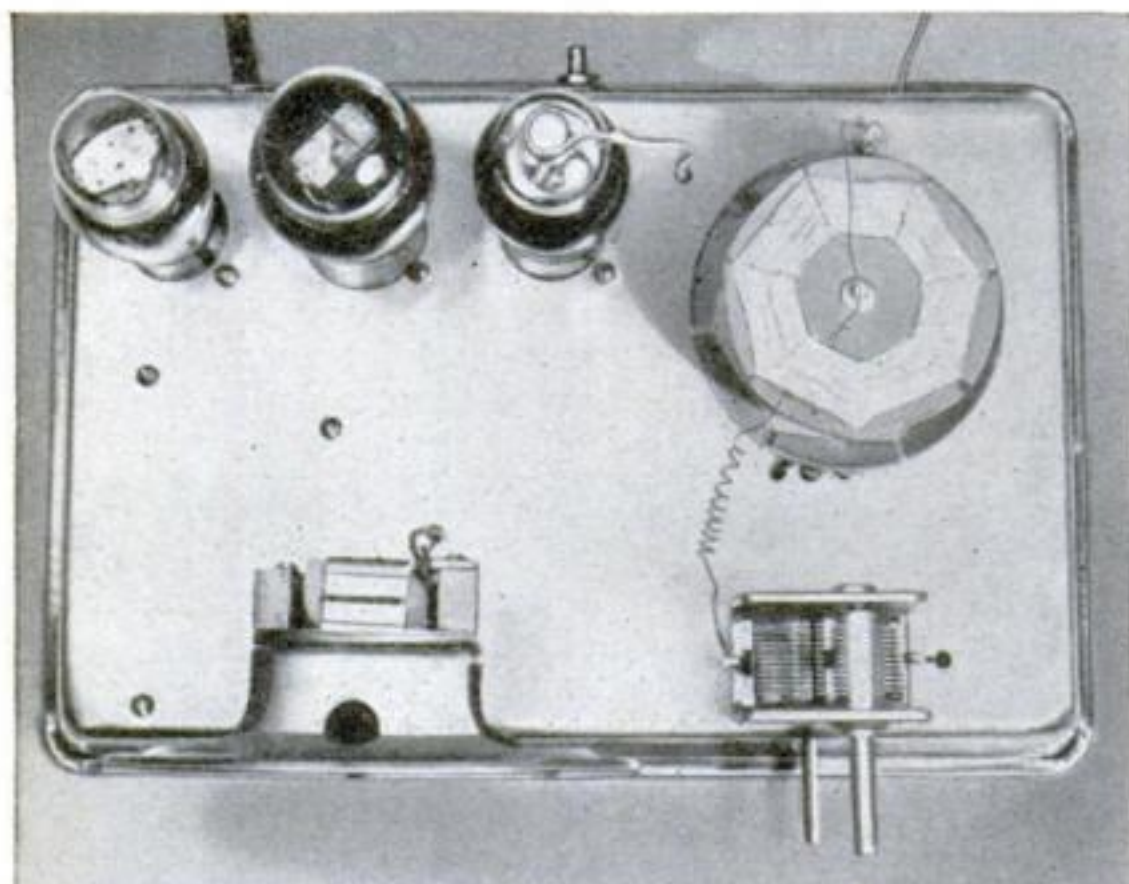
Midget Current Inverter



SMALL enough to fit inside many electric-phonograph cabinets, the compact inverter unit shown at the left makes it possible to run alternating-current phonograph motors where only direct current is available. The unit is simply plugged into a D.C. house outlet, and the phonograph cord is plugged into a socket on the case.



Four Dollars Builds



WHEN I finished building the receiver shown, I dubbed it the "Economy Three," for it had cost me only \$4.06, not including the cost of the wood for the cabinet, which I salvaged from my workshop scrap pile. It was an easy receiver to build; the hand-wound coils were easy to make, and the parts fitted nicely into the chassis with plenty of room to spare.

The chassis I purchased for ten cents at my neighborhood "five-and-ten." It's simply an inverted aluminum cake pan 10" long and 6½" wide. Being made of thin aluminum sheeting it was easier to work than most chassis materials. In fact, although I used a regular chassis punch to cut the three holes for the tube sockets, they could

Top and bottom views of the receiver showing the placement of the parts on the ten-cent cake-pan chassis. The regeneration control, set back from the edge, is mounted on a small bracket

LIST OF PARTS

Condenser, variable, .000365 mfd.
 Condenser, mica, .00015 mfd.
 Condenser, mica, .0005 mfd.
 Condenser, tubular, .005 mfd., 400 v.
 Condensers, tubular, three, .01 mfd., 400 v.
 Condenser, electrolytic, 20 mfd., 200 v.
 Condenser, electrolytic, 5 mfd., 25 v.
 Resistor, carbon, 1,000 ohm, 1 watt.
 Resistor, carbon, 2,000 ohm, 1 watt.
 Resistor, carbon, 600 ohm, ½ watt.
 Resistor, carbon, 300,000 ohm, ½ watt.
 Resistors, carbon, two, 1 meg., ½ watt.
 Regeneration control, 25,000 ohm.

Miscellaneous: Tubes, coil wire, cake-pan chassis, five-inch magnetic speaker, 200 ohm line-cord resistor, on-off switch, six-prong wafer sockets, wire, solder, etc.



A drill saves time, but holes can be cut with scissors

This Loudspeaker Set

By FRANK TOBIN

have been cut with an ordinary pair of scissors. Because of the pan's sloping sides, however, the 25,000-ohm regeneration control had to be mounted on a small aluminum bracket some distance behind the front edge as shown at the extreme left. The same screws that hold the variable tuning condenser can be used to support the bracket.

The A. C.-D. C. circuit is simplicity itself. It uses three tubes—a 43, a 6C6, and a 25Z5 rectifier—and provides sufficient pep to operate a loudspeaker. Be-

cause magnetic speakers are generally sensitive to weak signals, I chose one of that type. It cost me 93c.

The homemade coils are quite easy to wind. Before going into the actual construction details, however, there is one important point that must be remembered: In making the coils, adhere strictly to the



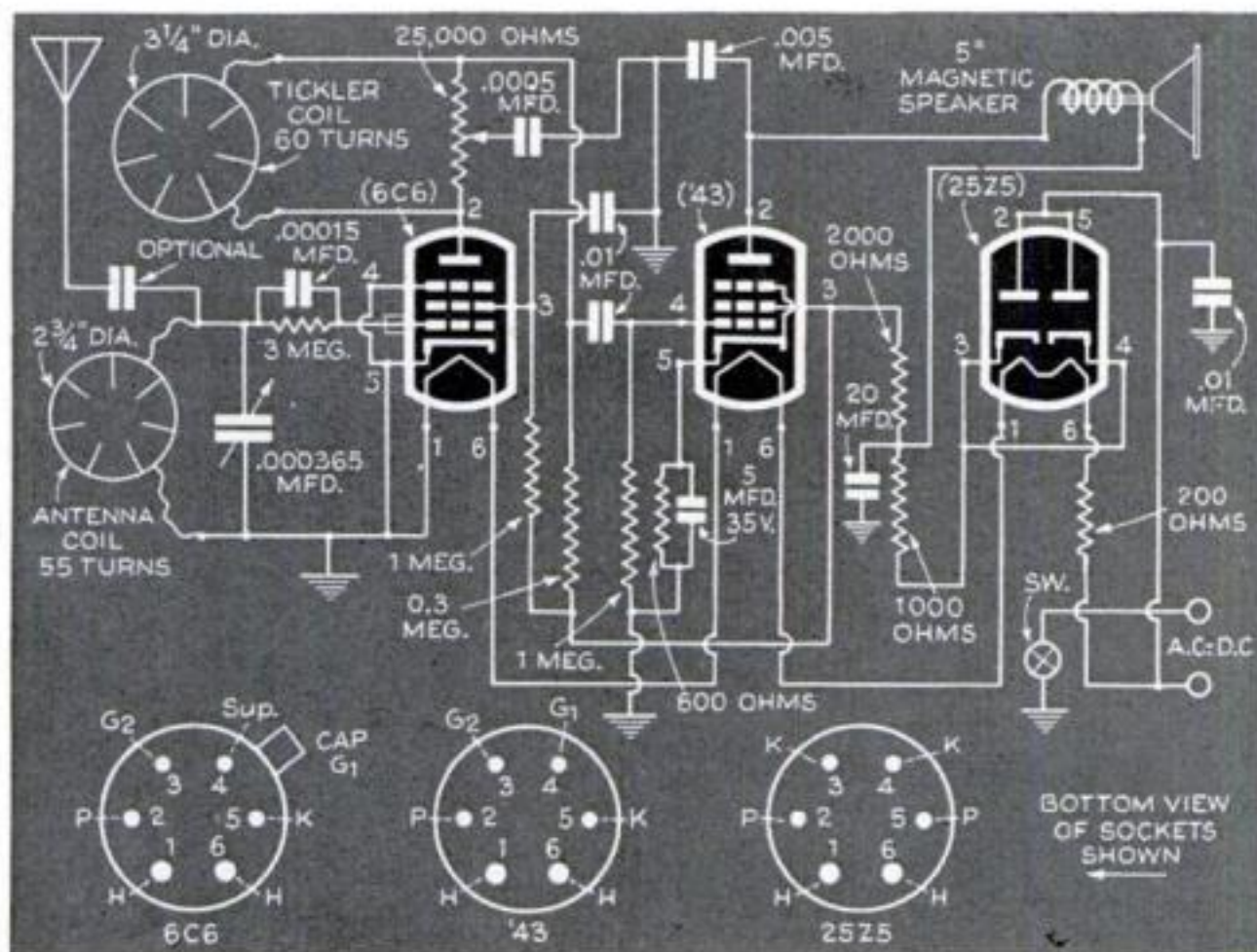
The completed outfit gives loudspeaker volume with a short antenna

specifications, such as the size of the wire, the length of the antenna attached to the antenna coil, the distance between coils, etc.

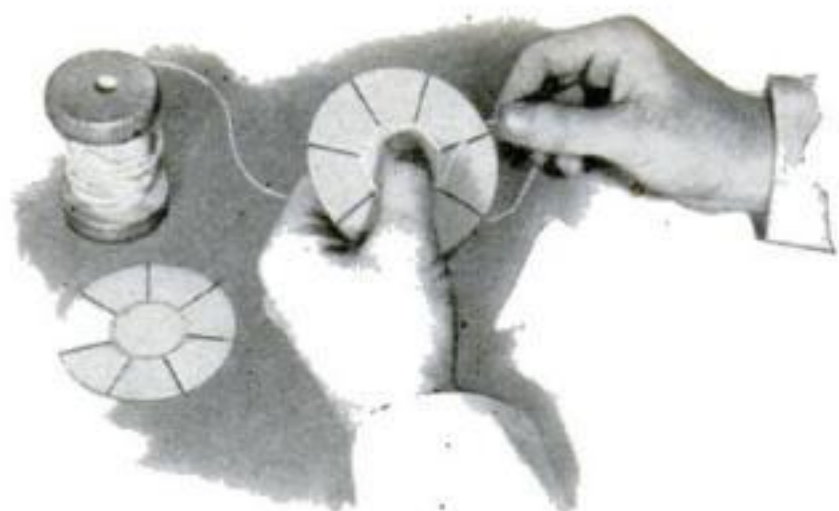
First cut out two round cardboard disks, one $2\frac{3}{4}$ " in diameter and another $3\frac{1}{4}$ ". Then divide each form into seven equal sections and cut a slot down each line about $\frac{1}{16}$ " wide to within $\frac{5}{8}$ " of the center. On

the smaller form wind 55 turns of No. 30 double-cotton-covered magnet wire. Pass the wire first over one section and then under the next—alternating as you go round. When finished, this will be the antenna coil. The larger coil is the tickler coil and consists of 60 turns of the same wire. In checking the number of turns, add the turns on two adjacent sections. In other words, a coil of 55 turns will have twenty-seven windings on one "rib" and twenty-eight on the next.

The coils are mounted on the chassis by means



Specifications for the circuit and the hand-wound pancake-type coils



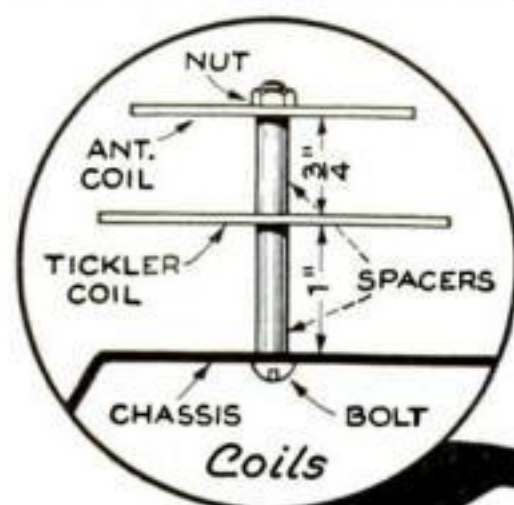
The wire goes over and under the form ribs

of a brass machine screw $2\frac{1}{2}$ " long and two brass-tubing spacers, $\frac{1}{4}$ " in diameter. The tickler coil should be placed nearest the chassis and 1" from it. The antenna coil should be placed $\frac{3}{4}$ " above the tickler coil. Refer to the drawing below for details.

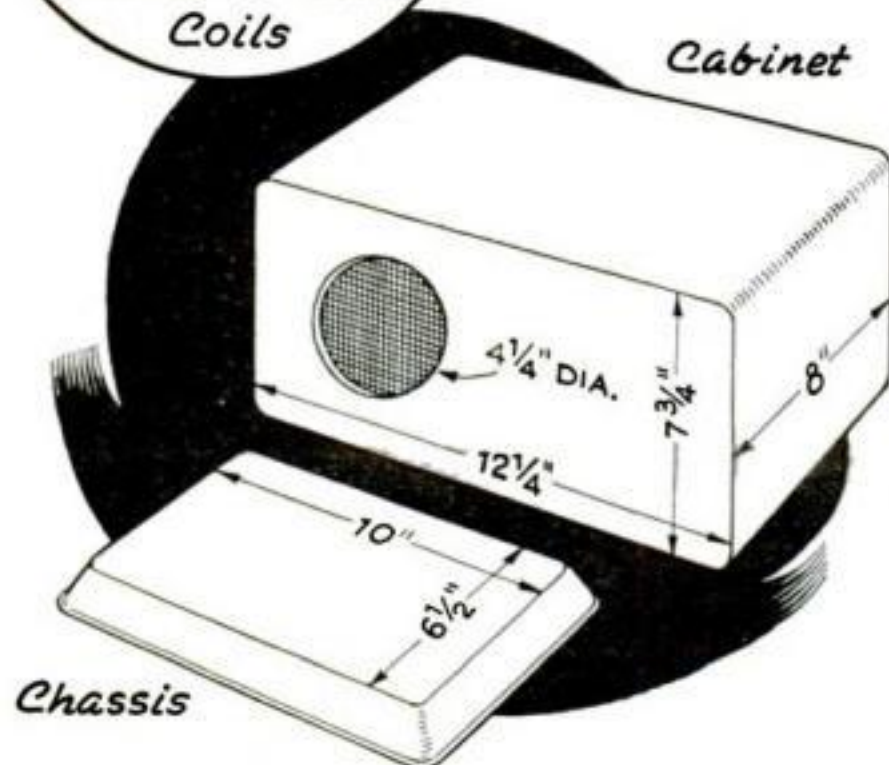
The cabinet, whose dimensions also appear in the drawing below, can be made of any wood that you may have in your scrap pile. It has an open back, and the chassis can be conveniently held in place with two screws driven into the baseboard.

A 25' antenna should be used and it can be left on the floor or hung out of a window. On my version of the set I used rubber-insulated stranded wire and it worked particularly well. If a longer antenna is desired, a .00005-mfd. fixed mica condenser must be inserted in the antenna lead.

By adding to or reducing the number of turns on the antenna coil, the set's range can be varied to receive stations just below or just above the broadcast band.



Dimensions for the cabinet and the cake-pan chassis, and mounting details for the two flat-wound coils



More Power

LAST month, as the first in a series of six articles on easily built circuits for radio experimenters, a two-tube all-electric receiver was described. This month, a stage of resistance-coupled audio-amplification will be added to give the set more power.

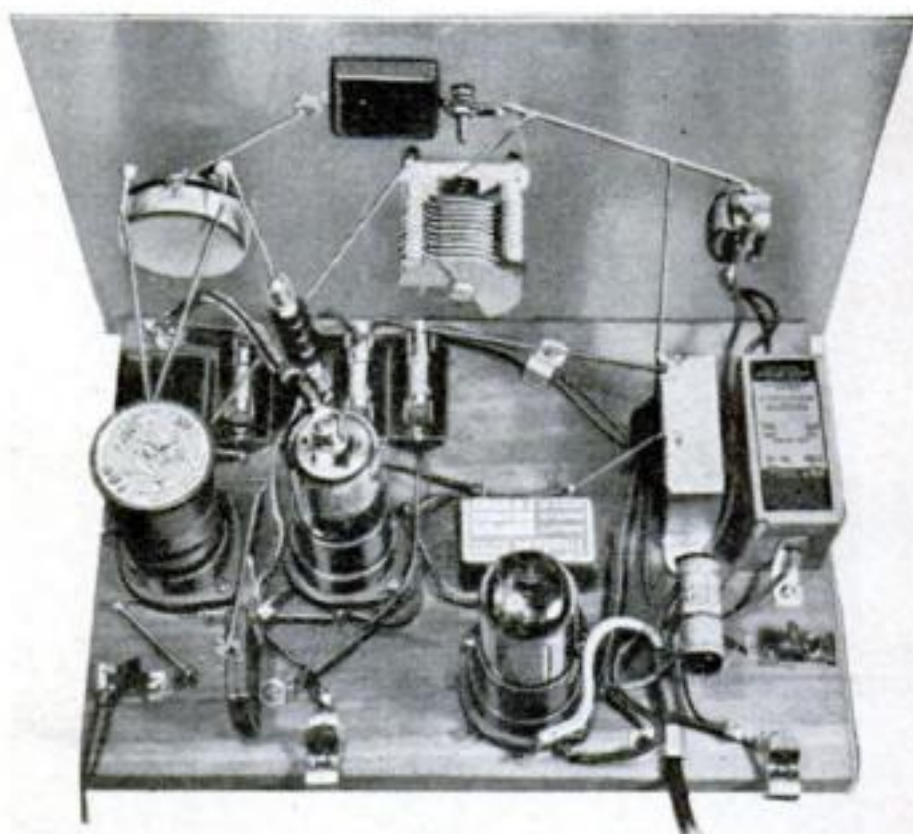
For the additional stage we will use the triode section of the 25B8GT tube used in the original design and six new items from the original list of parts. The new parts consist of a .002-mfd. mica condenser, a 200,000-ohm, $\frac{1}{2}$ watt resistor, a 1-megohm, $\frac{1}{2}$ watt resistor, a Fahnestock clip for the ground connection, and two fuse mounts to hold the resistors. The .002-mfd. mica condenser is used for coupling the detector stage to the audio stage and is mounted on the baseboard in a vertical position. In the photographs, it can be seen next to the antenna clip. The two $\frac{1}{2}$ -watt resistors are also mounted on the baseboard, next to the other resistors.

In order to avoid feed-back and undesirable oscillation, the grid lead to the

LIST OF PARTS

(Included in last month's list)

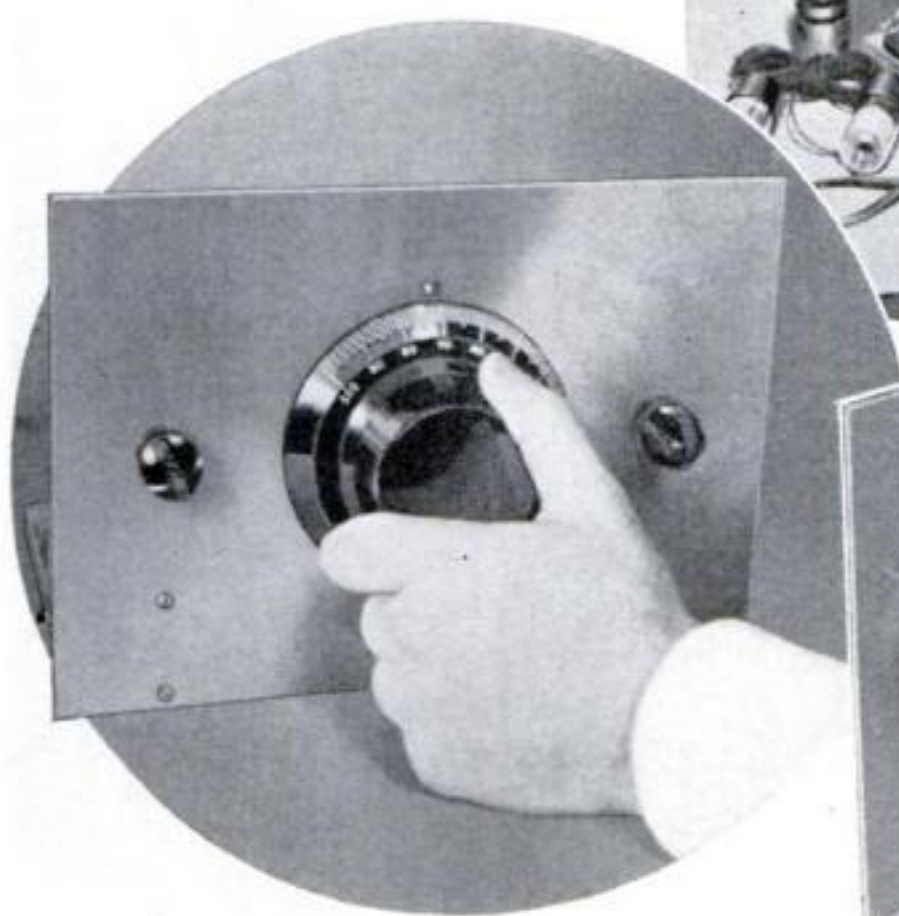
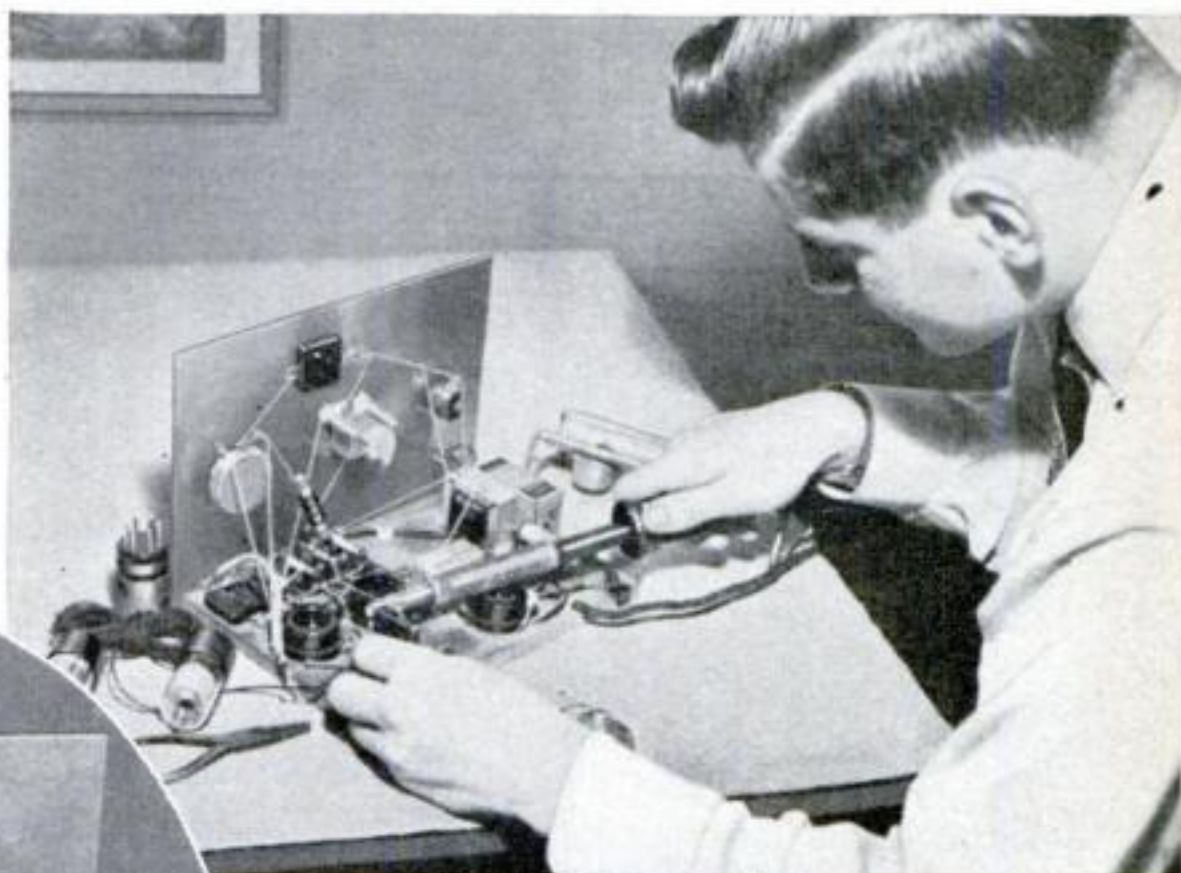
Condenser, mica, .002 mfd.
Resistor, Carbon, 200,000 ohm, $\frac{1}{2}$ watt.
Resistor, carbon, 1 meg., $\frac{1}{2}$ watt.
Fahnestock clip.
Two fuse mounts.



How last month's two-tube set should look after adding a stage of audio amplification

for Your Two-Tube Radio

A Stage of Audio Amplification Is Added to the Set Described in Last Month's Article

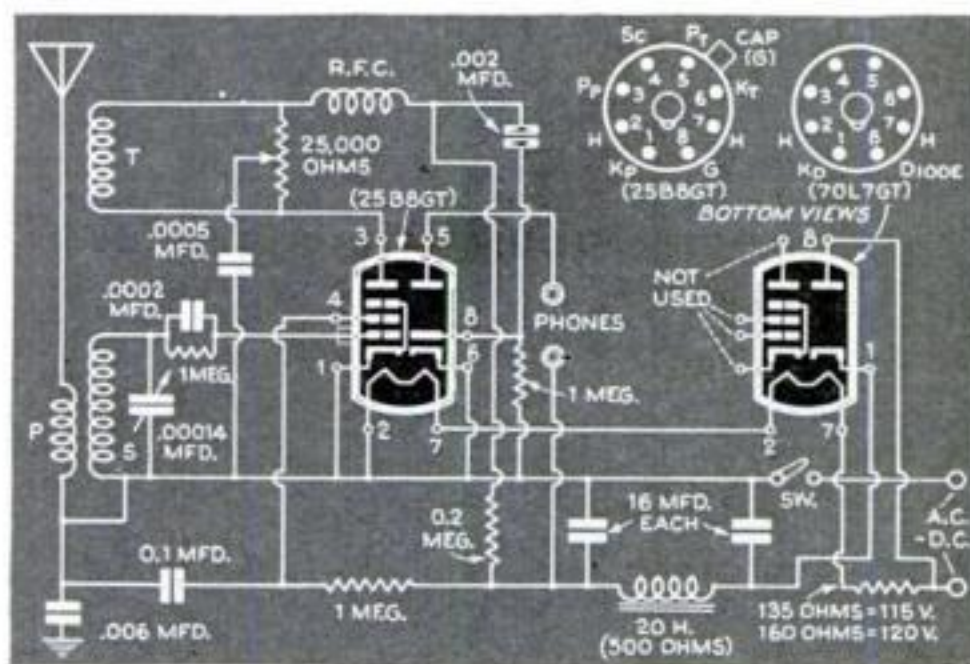
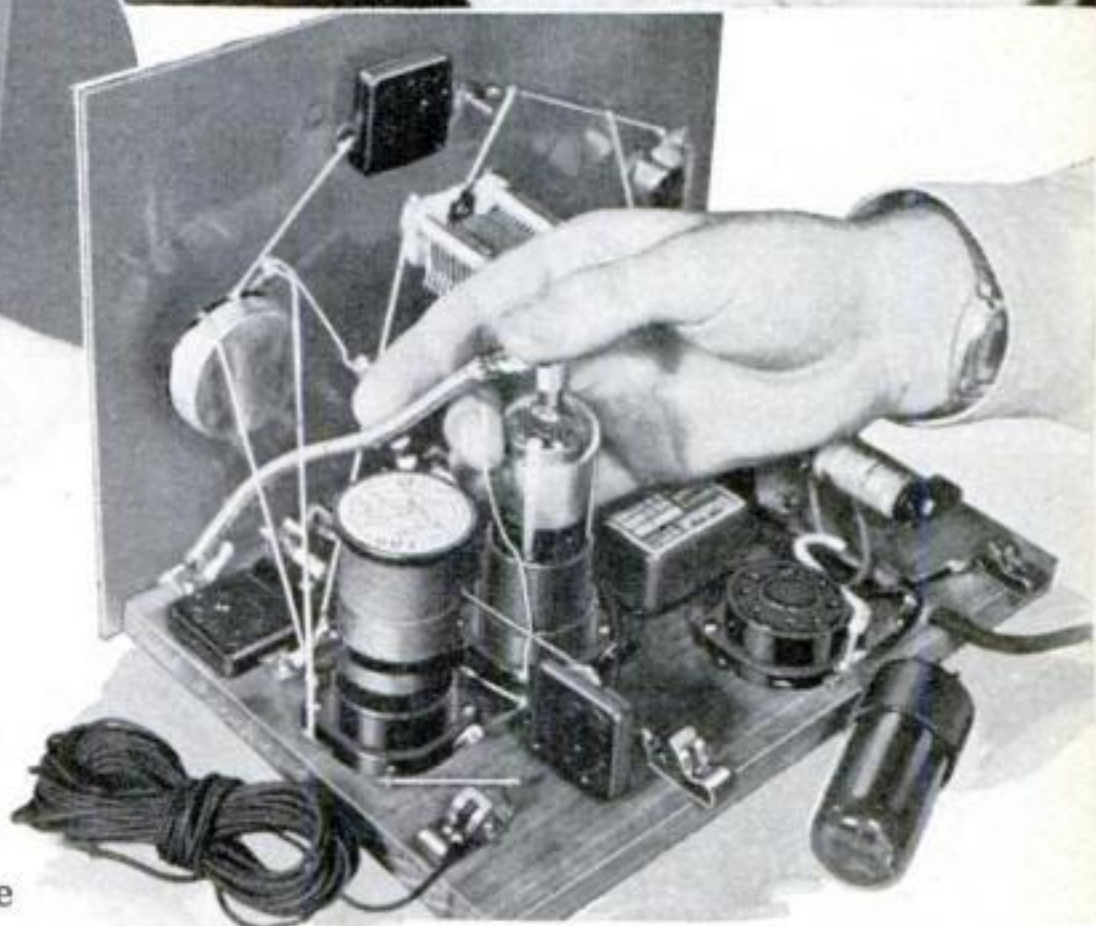


The grid cap lead to the 25B8GT tube should be shielded, as at the right, to avoid feed-back. It can be grounded to the panel

cap of the 25B8GT tube should be of the shielded type.

The .006-mfd. tubular condenser connected in the first design between the plate of the rectifier tube and the ground is now used for adding an outside ground connection to the set. The .006-mfd. condenser isolates the outside ground from the ground wiring in the set.

An indoor antenna 20' to 25' long is all that is needed with the audio stage. If a longer antenna is desired a trimmer condenser must be inserted in the antenna lead. How to build one from scrap parts will be described in the next of this series of articles.



Six additional parts provide the new amplifier circuit



The St. Joseph (Mich.) Homeworkshop Club, an affiliate of the National Homeworkshop Guild, held open house recently when a special lathe demonstration was given. A total of 128 men and women attended

What Guildcrafters Are Doing



Expert craftsmanship is displayed by many members of Guild clubs. Here is a breakfast table with chairs made by Morris Fisher, of Decatur, Ill., who belongs to the Staley Handicraft Club

Ray Portch, at right, is one of the thousands of craftsmen who are busy at present making toys to be given to poor children at Christmas. He is a member of the Walla Walla Wash. Workshop Club



As Easy as ABC

The DELCO ELECTRO-LEVEL Prevents Over-Filling

Remove the vent plug . . . and automatically the new Delco battery is protected against over-filling. Why is this protection important? When a battery is being charged, pressure is built up inside the cells by the gases which are released. These gases should pass freely through the vent holes; but when the electrolyte level is too high, acid is sprayed out. The acid corrodes the battery carrier and connections.

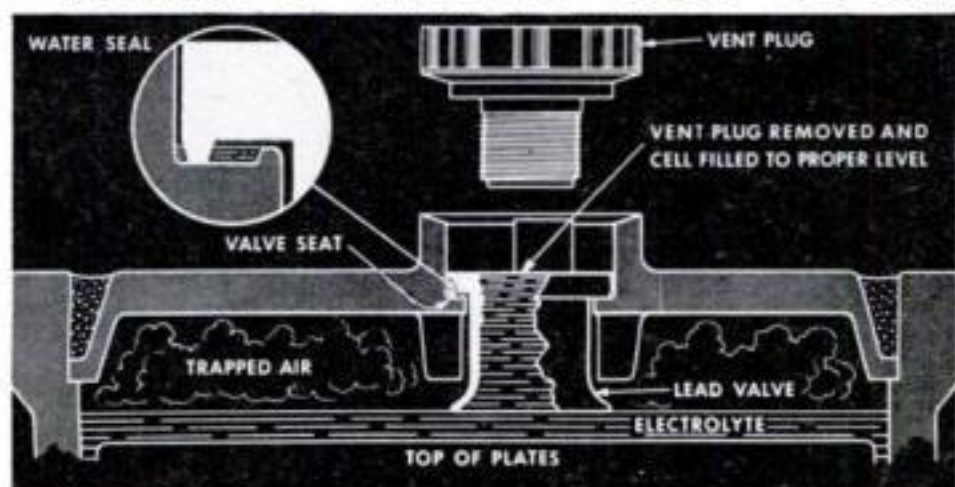
The secret of the automatic protection provided by the Delco Electro-Level is a sliding valve which drops down to form a water-sealed air lock when the proper electrolyte level is reached. When the plug is screwed in place, the valve is lifted to form an efficient



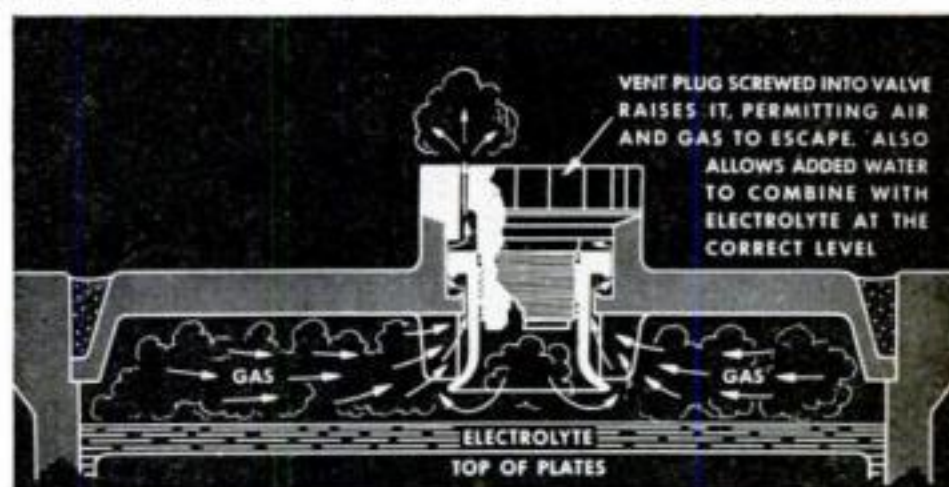
baffle arrangement that breaks up acid spray and allows only gas to escape.

Delco batteries are original equipment on 43 per cent of all new cars sold. For sure starting ability and dependability, replace with a Delco battery.

HERE'S HOW THE NEW ELECTRO-LEVEL WORKS



Vent plug removed for filling—valve forms air lock when electrolyte reaches proper level. Notice particularly the *water seal* formed when the edge of the valve drops into the layer of water retained in the ridge around the valve seat. This layer of water is replenished by condensation, eliminating any possibility of a leak in the air lock when the lead valve is in position for filling.



Vent plug screwed in—valve is raised to permit escape of trapped air and gases from the cell through the passage and the vent hole in the plug. Notice here the efficient baffle arrangement through which the gases must pass. This condenses moisture and breaks up the acid spray which might otherwise escape to damage the battery carrier and connections to the battery.

Delco-Remy

ANDERSON, INDIANA

World's Largest Manufacturer of Automotive Electrical Equipment

4 REASONS WHY "PRESTONE" ANTI-FREEZE IS 1ST IN AMERICA

1 *SAFE*

2 *PROVED*

3 *GUARANTEED*

4 *NOTHING ELSE LIKE IT*

"Prestone" anti-freeze has seen more motorists safely through more winters than any other brand.

The U. S. Army, Navy and 25 other Federal Bureaus use "Prestone" anti-freeze for the protection of vital equipment.

Behind "Prestone" brand anti-freeze is one of the most famous guarantees in motordom. It says plenty . . . in writing.

"Prestone" anti-freeze is ethylene glycol PLUS *special* processing and *exclusive* ingredients that make it America's finest anti-freeze.

One shot of "Prestone" anti-freeze lasts all winter. There's no replacing . . . no boil-away . . . no fumes . . . no foaming . . . no fire hazard. It is harmless to your cooling system . . . prevents rust and corrosion. See your dealer today.

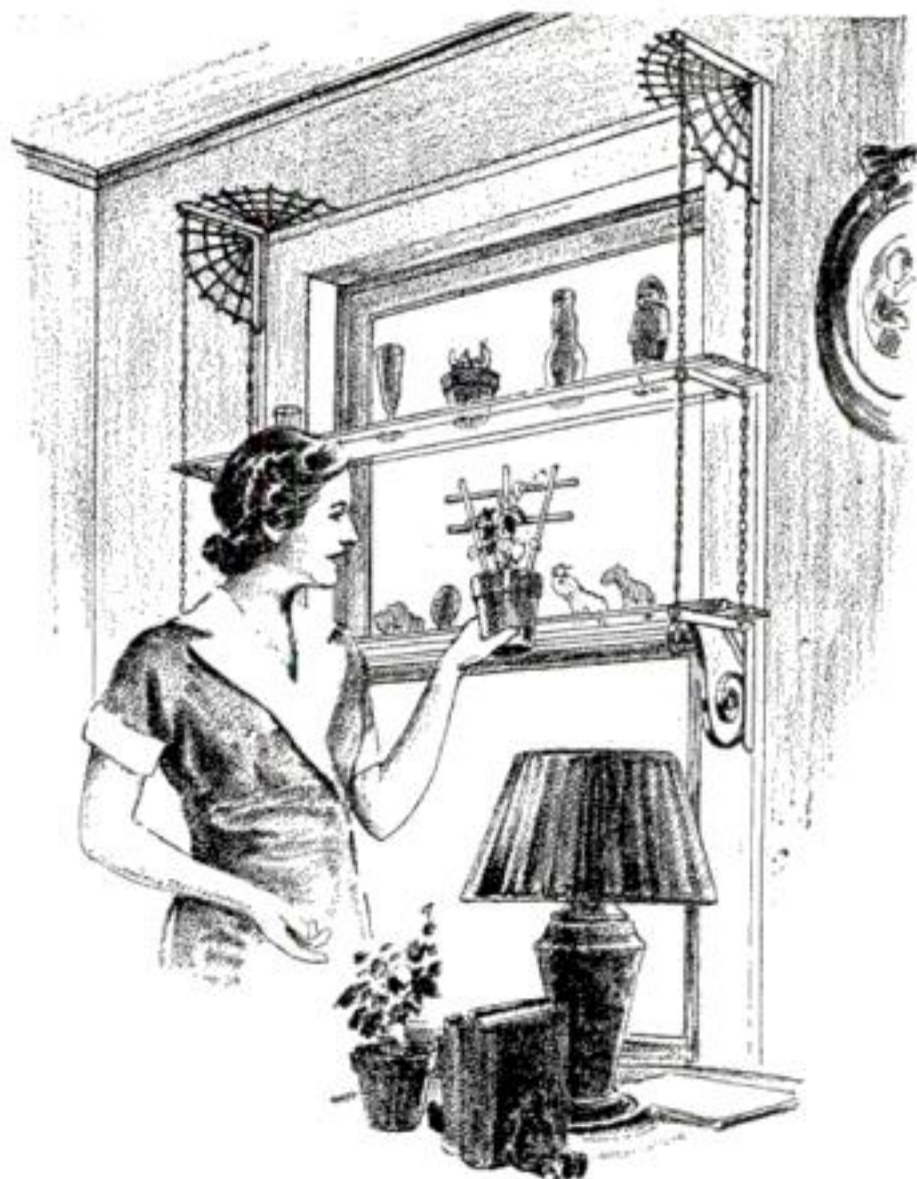
\$2⁶⁵
PER GALLON

The words "Prestone" and "Eveready" are registered trade-marks of National Carbon Company, Inc.



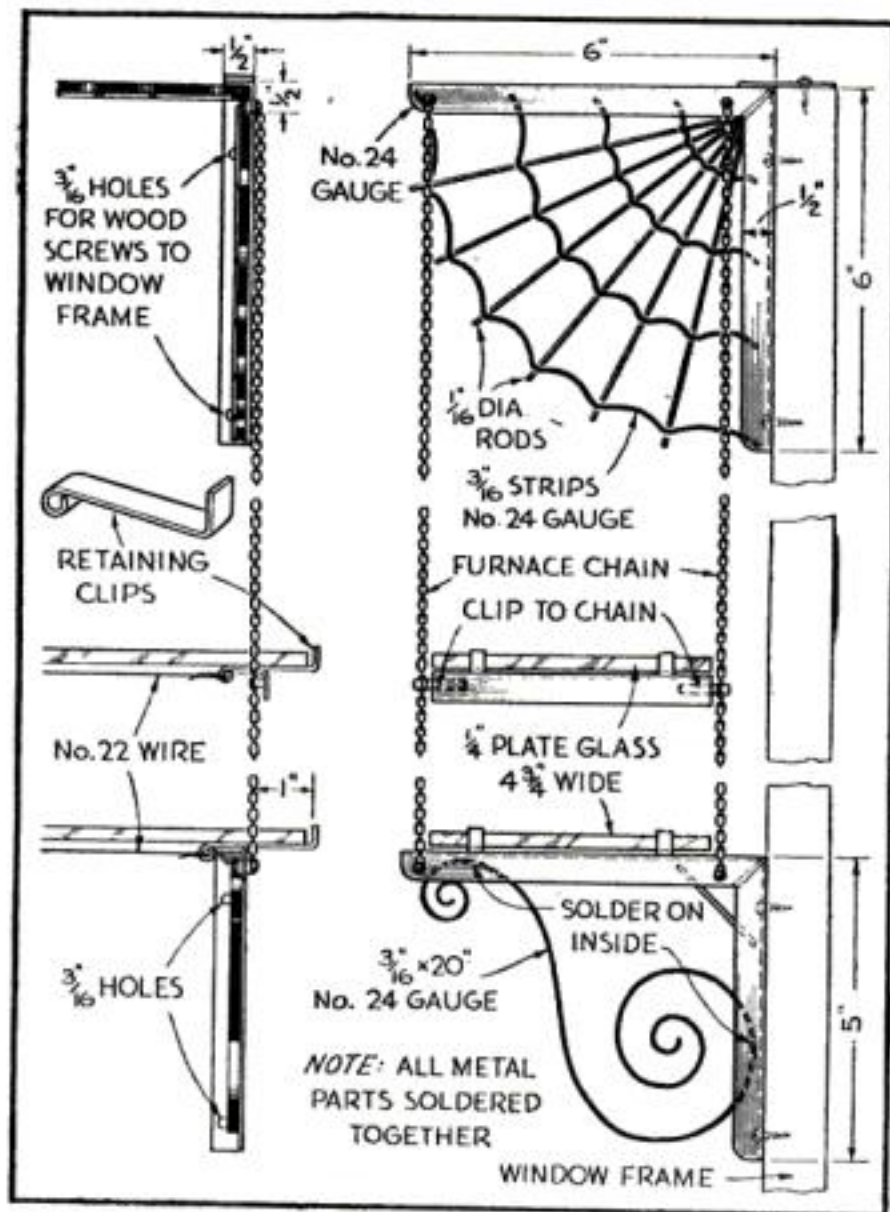
"PRESTONE" ANTI-FREEZE

"There's nothing else like it"



Window-Shelf Brackets of Spider-Web Design

PLATE-GLASS hanging window shelves have become popular, and a decorative arrangement can be made inexpensively as shown. The supports are of 24-gauge galvanized sheet iron (Continued on page 214)



"But, madame—I am an artiste!"



"Who, me?" said I, when this housewife asked me to polish her car for my victuals, "A retired impresario?" Whereupon she just handed me a can of polish and said, "No work, no food . . . get busy!" Which I did, for just then I smelled steak sizzling.



Imagine my joy! Why, this polish imparted a dazzling shine with scarcely more effort for me than when I wielded the baton for the Hoboken Philharmonic! "Ah, No. 7," I said, examining the can . . . "my favorite number!" Then I saw that it was "made by Du Pont."

"That No. 7 Polish," I confided, as I topped off my steak with a slab of pie, "is made by the same people who made the 'Duco' finish for my last three town cars. No wonder it bestows such a lustre! And using it left me so full of vigor I'd be charmed to chop some wood for you, Madame."



DU PONT NO 7 POLISH
made by the makers of DUCO* and DULUX*
*Reg. U. S. Pat. Off.

WANT A SAMPLE?



Du Pont, Dept. 6-SP, Wilmington, Del.

Send me a sample of No. 7 Polish—enough for hood and fenders. I enclose 6¢ to help cover mailing costs.

Name _____

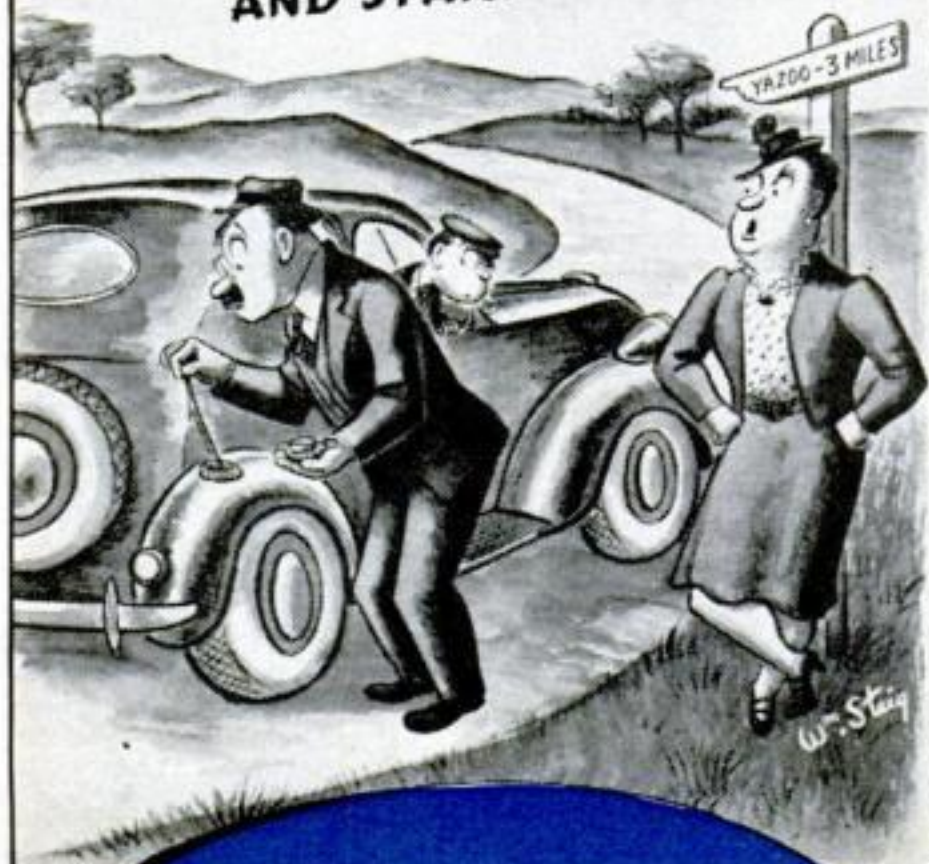
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(Offer good in U. S. only)

CLEAN AUTO UPHOLSTERY with DU PONT "TRI-CLENE," the non-inflammable cleaning fluid which leaves no odor.

"GUESS AGAIN
AND START WALKING"



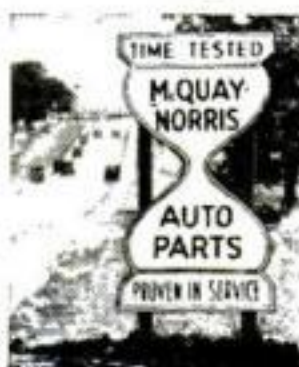
...and **GUESSWORK** leads to grief in motor repairing, too. Be safe. Get piston rings that are specifically *Engineered* for your particular model of car.

Insist on
McQUAY-NORRIS
ALTINIZED
Engineered Set
PISTON RINGS



There's no guesswork with these rings because each Engineered Set is specially made for one particular make and model of car and precision installed according to blueprint instructions. That's why these rings will stop oil waste and prevent blow-by in *your car*. And each ring is *Altinized*—an exclusive McQuay-Norris feature—to give long life and reduce wear.

McQUAY-NORRIS MFG. CO.
St. Louis, Mo.



1" wide, folded to an angle with $\frac{1}{2}$ " legs; and $\frac{1}{16}$ " diameter iron or brass rod. Common furnace damper chain is used to hang the $\frac{1}{4}$ " plate-glass shelves.

The top brackets are shaped to resemble a spider's web. All four brackets are permanently screwed to the window frame. As many intermediate shelves as desired may be hung directly on the chains. Each shelf should have two 22-gauge steel wires running lengthwise to act as a tie wire so that the shelves will not accidentally drop from under the end angles while being cleaned. Spans longer than 36" require heavier plate glass or else should be lightly loaded.

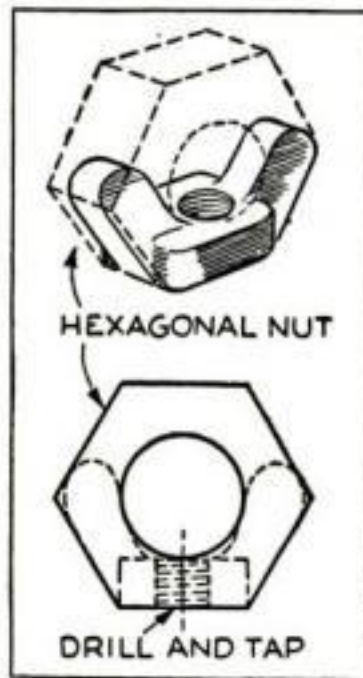
The metal may be gilded or painted flat black. The gilt is pleasing with dark window frames, the black with ivory or cream frames.—CARL F. H. SCHRADER.



Mounting Tissue Tacked with Soldering Iron

WHERE dry-mounting tissue is used for sticking photographs or drawings to mounts, the tissue usually is "tacked" in position first so the edges can be trimmed and other operations performed without its slipping. The tacking is done with a warm, blunt-nosed tool. Such a tool can be improvised quickly from a small soldering iron and a piece of sheet copper.—W. E. B.

Quickly Made Wing Nut



RECENTLY I needed a $\frac{1}{4}$ " wing nut, but none was on hand or could be purchased in the neighborhood. I made an acceptable substitute from an ordinary $\frac{1}{2}$ " hexagonal nut. First I drilled a hole in one of the sides and tapped it; then I cut the nut in two a little above center and also cut down and filed the sides to shape.—FRANK GROSS.

You may worry about the plumbing



but here is one worry you can avoid

With proper care you might have avoided the worry of that leaky pipe. That's true about chassis lubrication too.

A haphazard job with ordinary grease means early repair bills. That's why it is important to remember one word: "MARFAK," which means our 40-point Chassis Lubrication Service. We are trained in a special Texaco lubrication school. We work from a special Texaco "Lubrication Guide," so we don't miss a point on *your* car. We use Marfak lubricants. They last twice as long as ordinary grease.

Look for the bright red sign, "Let us Marfak your car," at Texaco and other

good dealers' stations and leave your chassis lubrication worries with an expert.

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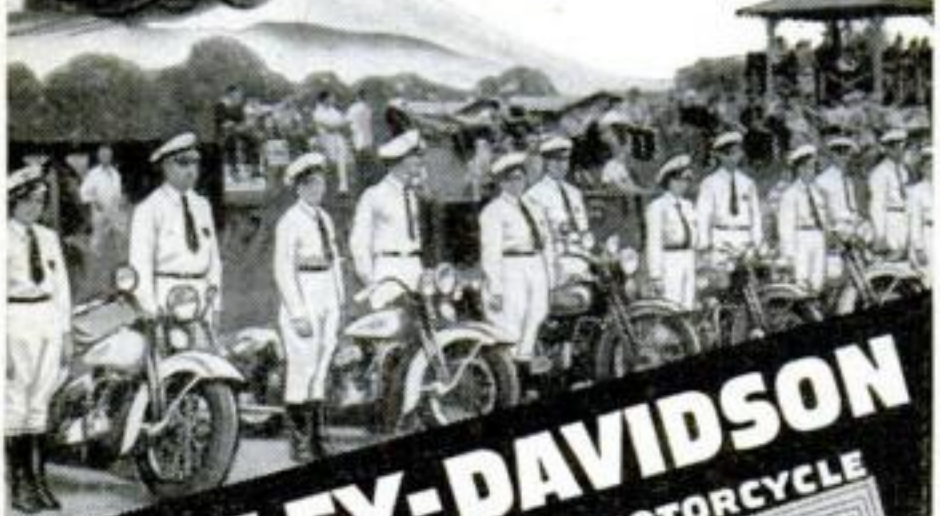
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MAGAZINE

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Dept. PS, Milwaukee, Wis.
Send FREE copy of big 24-page "Enthusiast" magazine filled with thrilling motorcycle pictures and stories. Also literature on the new Harley-Davidsons. Stamp is enclosed for mailing cost.

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WHEN you are making furniture, models, boats, and other articles in your workshop, accurate, detailed blueprints simplify the work considerably. Ever since 1922 we have provided readers with authoritative drawings for many projects at a nominal cost, and this service has grown to be the greatest of its kind. Some of our plans are listed below; a complete list will be sent free upon receipt of a self-addressed, stamped envelope.

MODELS

Barbary Pirate Galley or Felucca, 20" long, 44-45-R	\$.75
Barnegat Lighthouse, 10½" high, 298A .....	.25
BLUENOSE, famous fishing schooner, 17½" hull, 110-111-112-R	1.00
Clipper Ship GREAT REPUBLIC, 31½" hull, 272-273-274-R	1.25
Clipper Ship SEA WITCH, 9½" hull, 219 .....	.25
Concord Stagecoach DIAMOND TALLY-HO, 20½" long, 115-116-117-R	1.00
Confederate Raider ALABAMA, 21½" hull, 335-336-337-R	1.50
Elizabethan Galleon REVENGE, 21" hull, 206-207-208-209	1.00
Fishing Schooner WE'RE HERE of "Captains Courageous," 9½" over all, 351-R .....	.50
H. M. S. BOUNTY, 8½" hull, 254 .....	.25
Liner QUEEN MARY, 10¼" hull, 283 .....	.25
Miniature Fleet of Nine Modern U. S. Fighting Ships (full-size plans and instructions in booklet form), 372-R .....	.50
NOURMAHAL, power yacht, 8½" hull, 276 .....	.25
Ocean Freighter, 14" hull, 271 .....	.25
Revenue Marine Cutter JOE LANE, topsail schooner, 13½" hull, 374 .....	.75

FURNITURE

Bedside Cabinet, with automatic light in top drawer; also Fireplace Screen and Trinket Box, 389A .....	.25
Bookcase for Holding Copies of Popular Science Monthly, 353A .....	.25
Double-Decker Bed, 277A .....	.25
Early American Round-Top Stand, 191A .....	.50
Fireside Bench, Colonial, 187A-188A .....	.50
Floor Lamp, with tripod base, 243A .....	.25
Four-Leaf Card or Occasional Table, 239A .....	.25

(Continued on page 218)

GOOD LIGHT

the most important tool in your Home Workshop



1

TRY THESE TIPS to get more out of it

1. In a small home workshop you need at least two 150-watt G-E MAZDA lamps in RLM reflectors. Be sure to mount units *over front edge* of bench, not halfway from front to back; you'll see pencil marks better.

2. For better light, put a 150-watt Silvered Bowl G-E MAZDA lamp in each reflector. The mirror-silvered reflector built into this bulb gives you generous, diffused light for easier seeing.

3. In a larger shop, you need more of these units. To have even lighting along the work bench, the distance between units should not be more than one and one-half times the distance from unit to bench.

4. For flexibility, some workers like this "trolley" lighting system. Lighting units glide on a "live" but protected channel... commercially available... to bring you light where you want it.

5. Need "daylight"?... for painting or other color discrimination? Look into fluorescent lighting with the new G-E MAZDA F "Daylight" lamps. It's cool, pleasing and abundant... in daylight quality.

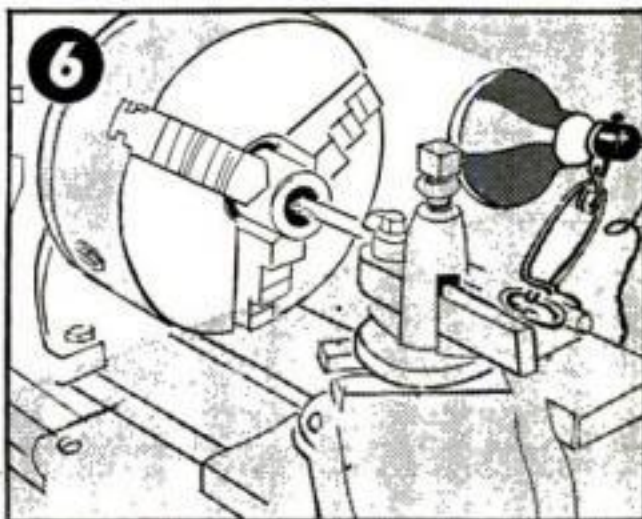
6. Horizontal boring and many another job in workshop or home becomes easier with a handy utility light like this... a G-E MAZDA Reflector lamp in clamp-on socket, that helps you put light wherever you need it.

7. Avoid trouble, save steps and time: Use G-E MAZDA lamps (10c) to indicate "live" circuits... warning that your glue-pot is on... telling you, upstairs, that basement and bench light are "on."

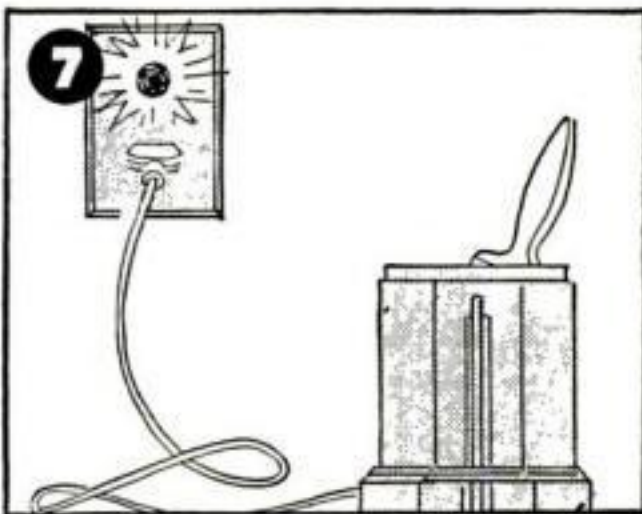
8. Be sure that the lamp bulbs you use for your home workshop and *all over your house* are G-E MAZDA lamps... the kind that are *made to stay brighter longer.*



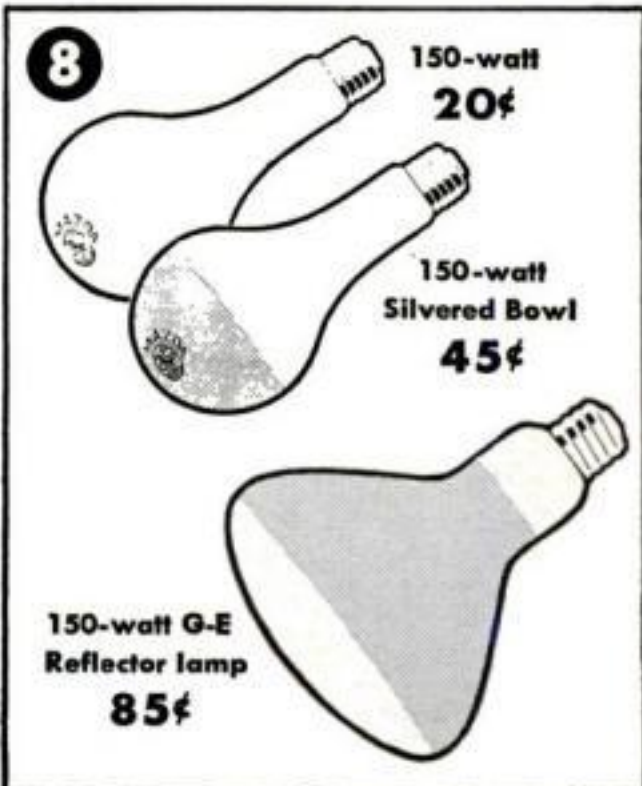
5



6



7



8

150-watt
20¢

150-watt
Silvered Bowl
45¢

150-watt G-E
Reflector lamp
85¢

G-E MAZDA LAMPS
GENERAL  ELECTRIC

KNOW YOUR TOOLS

To keep pace with modern industry's requirements, a knowledge of filing *fundamentals* isn't enough. *Specialization* is the watchword . . . fast production and high efficiency demand special-purpose files for various metals and alloys.

Can you choose or recommend the *right file* for a given job? Employers will thank you if you can. And you'll be more valuable to yourself!

Nicholson makes more than 3000 kinds, sizes and cuts of files. What filing problem may we help you solve? We've Technical Bulletins that will help you. Mill supply and hardware dealers carry many special and general purpose files in Nicholson or Black Diamond quality brand.

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● ALUMINUM "A" FILES—Special cut for fast, non-clogging filing of ductile-metal castings, sheets and bars.



● LONG ANGLE LATHE FILES—For clean shearing, self clearing, and smooth finishing under light pressure.



● DIE-CAST FILES—For finishing die castings of aluminum-alloy and similar metals.



● BRASS FILES—Designed to hold file to line of work, yet break up filings, keep file clear.

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SEND FOR THIS
INTERESTING
BOOK—FREE

Plans for the Workshop

(Continued from page 216)

Hanging Wall Cabinet, 9½" by 24" by 41¾", 280A	.25
Magazine Rack, ladder-back style, 250A	.25
Silverware Chest on Stand, 256A	.25
Smoking Stand, modern, 238A	.25
Tea Wagon, with removable tray and drop leaves, 20" by 30" top (turning), 13	.25
Upholstered Stool, 240A	.25

BOATS

Cabin Cruiser, 17' long, for use with outboard or inboard drives, 356-357-358-359-R	1.50
Camper's Utility Boat, 11' 2" long, canvas-covered, for outboard motor or rowing, 281-R	.50
Canoe, 16' canvas-covered kayak; can be used with sail, 192-193-194-R	1.00
Canvas-Covered Duck Boat, 13' 6" long, 279-R	.50
Family Runabout, 13' 5½" long, weighs 275 lb., for outboards from 1 to 60 h.p.; can also be rowed, 378-379-380-R	1.50
Fisherman's Outboard Boat, 9' 3" or 11' 6" long, weighs 115 or 160 lb., for motors from 3 to 16 h.p.; can also be rowed, 344-345-R	.75
Inboard Boat, 15' long, for motors from ½ to 5 h.p.; can also be rowed, 384-385-R	.75
Lapstreak Skiff, 13' 9" long, weighs 225 lb., for 1- to 16-h.p. outboard motors, 363-R	.50
Midget Boat or Pram, 9' long, weighs 75 lb., for oars, sail, or outboard motor, 339-R	.50
Motorboat-Rowboat, 13' long, decked hull, for use with outboard or inboard drives, 147-R	.50
Same, 14½' long, 148-R	.50
Same, 16' long, 149-R	.50
Plywood Dinghy, 9' 7" long, weighs 60 to 75 lb.; can be rowed, sailed, or used with small outboard motor, 387-388-R	.75
Racing Runabout, 13' stepless hydroplane for outboard motor, 261-262-R	.75
Racing Sailboat BLACKCAT, 13' 4" long, weighs 250 lb., Marconi rigged, 321-322-323-R	1.00
Sailboat, 12' long, weighs 200 lb.; has fast skimming-dish hull, 314-R	.50
Sectional Rowboat, 9' 8" long, two sections, weighs 60 lb., all-wood construction; can be used with small outboard motor, 340-341R	.75

MISCELLANEOUS

Aluminum-Trimmed Cheese Tray, Letter Opener, and How to Make Concrete House Numbers, 390A	.25
Baby's Crib and Play Pen, 26	.25
Birds and Animals, jig-saw patterns, 56	.25
Colonial Design Doll's House, 72	.25
Doll's House Furniture, 73	.25
Giant Repulsion Coil, Photographic Press, and Hammered Aluminum Crumb Tray and Scraper, 376A	.25
Microscope Kit, portable, 220	.25
Photo Range Finder, Sailboat Door Stop, and Woodpecker Door Knock, 369A	.25
Projector for Photos and Pictures, 259A	.25

LEAFLETS AND BOOKLETS

Hints on Cutting and Drilling Glass	.15
Home Workshop Index for 1938	.10
Home Workshop Index for 1939	.10
How to Build and Operate an Inexpensive Arc Welder and Spot Welder	.50
How to Make Your Own Marionettes	.50
Inexpensive Photo Equipment You Can Make Yourself	.50
Workbenches and Tool Cabinets (leaflet)	.10

Popular Science Monthly

353 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

I am inclosing.....dollars.....cents

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City and State
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THIS 1941 RADIO FOR ONLY \$**

MIDWEST

19⁹⁵

MIDWEST

**14-TUBE^{*}
CHASSIS**

COMPLETE WITH TUBES
AND SPEAKER READY
TO INSTALL IN YOUR
PRESENT CABINET

**30
DAYS
TRIAL
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EASY
TERMS**

FACTORY-TO-YOU SAVES ^{UP TO} 50%

**FREQUENCY MODULATION
AND TELEVISION PROVISION**

NOW, you can enjoy the mighty power
of a 14-Tube* radio, at the amazingly
low, factory-to-you price of only \$19.95.

You never heard such brilliant
performance and beautiful tone for so
little money! Now, tune in exciting
broadcasts direct from distant overseas
stations. Our famous 30-day prove-it-
yourself plan, fully protects you and
enables you to prove Midwest's
super performance in the privacy of
your own home, without obligation.

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Do like thousands have done—put this
new 1941 chassis in your present cabinet.
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from 5 to 17 Tubes, and up to 5-Wave
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history in the making before it appears in
your local paper, and, before your local station
announces its own version of the news!

*Fourteen tubes include Rectifiers.
Control and Tuning Eye Tubes.

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SEND YOUR NAME AND ADDRESS ON 1¢ POSTCARD**

MIDWEST *Factory-to-You* RADIOS

MANUFACTURERS OF QUALITY RADIOS SINCE 1920

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Cincinnati, Ohio, U. S. A.
Dept. 59-EE

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User-Agents Make Easy Extra Money. Check here () for details.

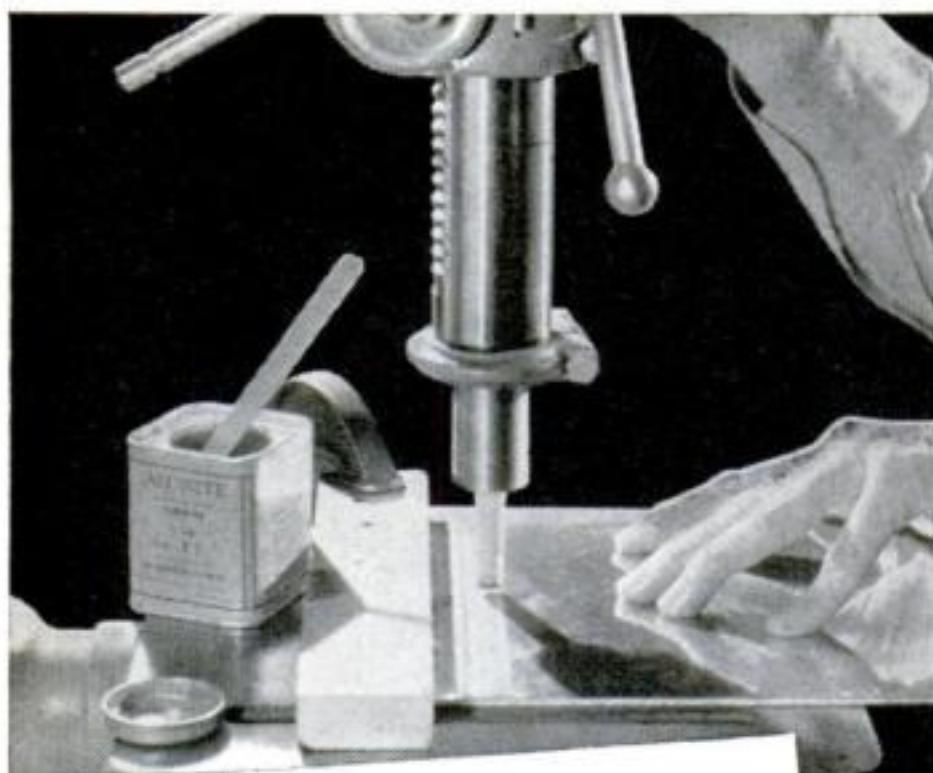
**FREE
RADIO
CATALOG**

**GET
MIDWEST'S
ANSWER
TO
TRADE-
INS!**

**14-TUBE
CABINET
MODEL**

**\$ 29⁹⁵
COMPLETE**

SHORT CUTS FOR THE HOME CRAFTSMAN



How to Spot A Metal Surface

• Here's an easy way to produce that attractive design called spotting or frosting, usually seen on the backs of watch movements or on the beds of fine lathes. You simply glue a disc of leather or felt on the end of a short piece of dowel rod, and charge it with fine Carborundum Brand Silicon Carbide or Aloxite Brand Aluminum Oxide Powders. Then place the dowel rod in the drill press chuck and revolve at slow speed. When the charged tip is brought against a polished metal surface a series of fine rings will be engraved in the metal. These rings or discs arranged in orderly rows produce the desired effect.

Ask your hardware dealer or mill supply house to show you the complete line of Carborundum-made coated abrasives, sharpening stones, grinding wheels and other abrasive products for the home craftsman. Send 10¢, coin or stamps, for souvenir sharpening stone and valuable illustrated manual on how abrasive products can save time and help you do better work.



Write Dept. S 100

THE CARBORUNDUM COMPANY

REG. U. S. PAT. OFF.

Niagara Falls, N. Y.

[Carborundum and Aloxite are registered trade-marks of
and indicate manufacture by The Carborundum Company]

Copper Keeps Tree Roots from Entering Drains

TO STOP tree roots from entering vitreous (clay) sewer tile, mix 1 lb. genuine copper bronzing powder to 100 lb. of the dry mortar mix used in laying the pipes. As soon as the mortar cracks through settling or other injury, the embedded copper becomes exposed and quickly acquires a coating of basic copper acetate. Although this is insoluble, it is deadly poison to tree roots coming in contact with it and prevents further growth.

Copper powder sprinkled over the so-called "hot-dog" type of asphaltum packing has the same effect in stopping the entrance of tree roots into the joint.

Where trouble with tree roots is anticipated with sewers already laid without this type of protection, three parts flour and one part of copper may be mixed thoroughly with water to a thin, creamy consistency, then diluted to four or five times its volume with water and poured down the sewer. A small amount will adhere to the greasy sides of the tile and poison any tree roots growing into the pipe. The roots, when poisoned, will rot away.—W. EDWARDS BROWN.

Powdered Rosin Helps Hold Turned Work in Chuck

ROSIN crushed to a fine powder forms a good binder when necessary between turned work, such as wooden bowls, trays, or boxes, which have to be finished by the so-called "chucking" method, and the hollowed wooden chuck. In this process, the chuck or faceplate form is a piece of scrap wood turned down on the lathe until it makes a tight fit with the already turned part of the work. The rosin is dusted on the form and on the turned part of the work, and the two are fitted together tightly. The unfinished part of the work is then ready to be turned without danger of slipping.—J. R. H.

Old Phonograph Record Serves as a Sanding Disk

I HAVE found an old phonograph record makes an excellent disk sander when used on a circular saw mandrel. The record should be fairly thick; cheap, thin records are useless for the purpose. First cut the record the same diameter as the circular saw and enlarge the small center hole to fit the saw mandrel. Cement a sheet of sandpaper to each side, and trim to shape. A sheet of No. 0 paper on one side and No. 1 on the other side is a good combination. Ordinary rubber cement gives satisfactory results for fastening the paper.—EMERSON W. BALL.

Here's the perfect 10" BAND SAW for your Workshop

**Inside
Secrets
of Delta Quality**

**"PRE-LOADING
BALL BEARINGS"**

Delta ball bearings are pre-loaded to make Delta machines more accurate in operation. Here's what this means to the prospective purchaser of power tools:

In the design and manufacture of ball bearings it is practically impossible to remove all of the "play" or clearance. In other words, a perfectly close fit between the ball bearings and the races in which they run cannot be obtained. This play is not visible to the naked eye. It can only be measured by means of accurate instruments.

Yet, this extremely small variation will keep the bearing from running absolutely true. In a drillpress it will cause a fine drill to wobble from side to side. In a shaper it will make the knives rise and fall, producing an uneven cut.

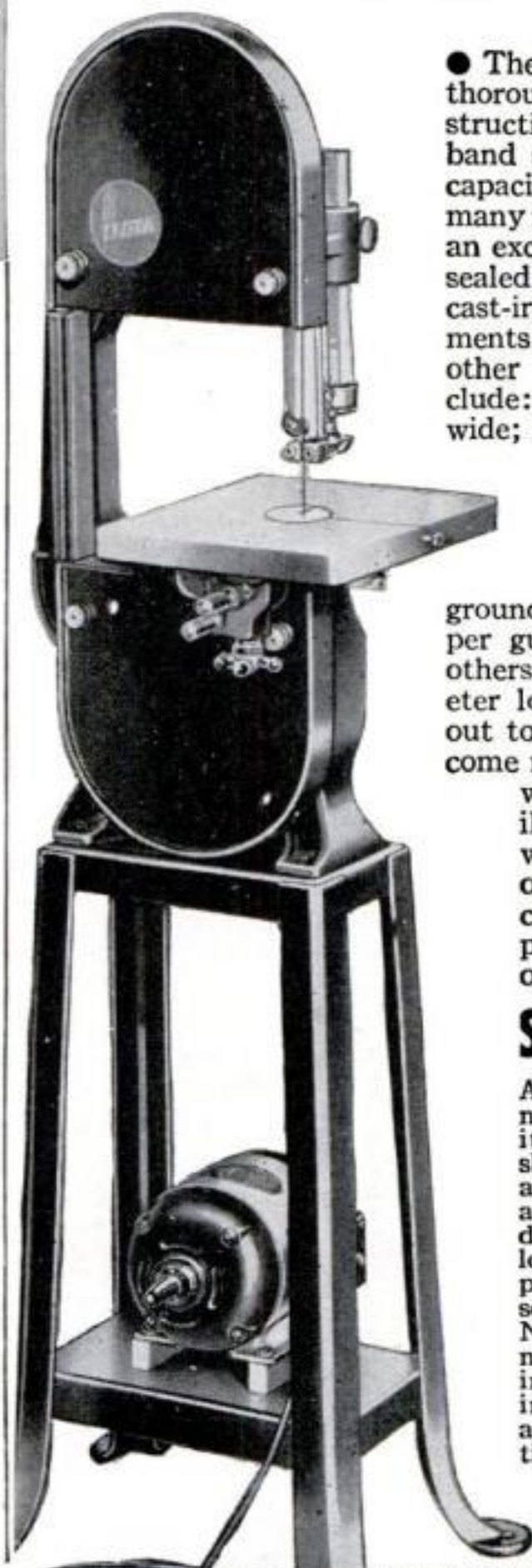
Pre-loading ball bearings as practiced by Delta, eliminates all of this.

The method used in holding the bearing in all Delta tools puts a definite amount of pressure on the bearing races so that the ball bearings ride against both of the races all of the time.

Neither the inner race or the outer race can shift out of place—they are always in the same position. This means that it is impossible for the bearing or the shaft which revolves in it to run out of true. Thus you always have uniform accuracy in Delta machines.

If you want the best in power tools be sure that the bearings are "pre-loaded." Have the salesman demonstrate it to you and prove to you without a doubt that the ball bearings are pre-loaded.

Pre-loading is another superior exclusive feature of Delta tools—a feature not visible to the naked eye—a feature too often passed over lightly, yet one which is of vital importance to you.



● The massive design, advanced engineering, thoroughly studied design and accurate construction of this machine make it the finest 10" band saw ever offered to the craftsman. Its capacity under the guide makes it the equal of many machines of larger throat capacity. It has an exceptionally rugged heavy frame; double-sealed ball bearings lubricated for life; heavy cast-iron 11" x 11" table, micrometer adjustments in upper and lower guides and many other features. Some of its specifications include: Overall Dimensions: 33½" high; 11¾" wide; 23" front to back. Capacity: 10" blade

to upper arm; 6" under guide. Accurate, true-running balanced wheels, carried on self-sealed New Departure ball bearings—lubricated at factory for their entire life. Heavy accurately ground main shaft. Micrometer-adjustment upper guide. Each adjustment independent of others, and each made with precision. Micrometer lower guide, with adjustments brought out to front of table. Operator's hands never come near blade. An exclusive feature. Upper wheel tilting device and tension scale similar to that used on 14" band saw. Both wheels and blade thoroughly guarded; only portion of blade actually used for cutting is ever exposed. For full details, prices on this and other Delta tools, fill out the coupon.

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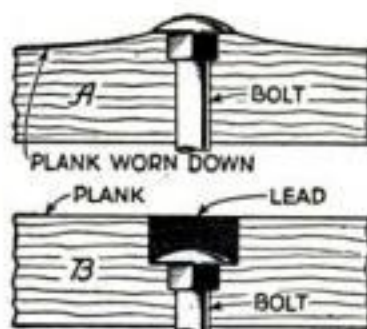
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BY THE MAKERS OF MOBIL OIL

Improved Way to Fasten Floor of Stock Truck



WHEN the floor of a stock truck becomes worn, the boltheads are left projecting as shown at A, which makes it difficult to clean the floor since the shovel continually catches on the projections. A good way to avoid this difficulty is to lay the planks as at B with the bolts countersunk considerably below the surface and then fill the holes with molten lead. This provides a floor that remains comparatively smooth because the lead, being quite soft, wears down with the wood.—W. J. W.

Paint Thickened with Whiting for Coating Cracked Boards

THE siding or weatherboards of an old house were cracking, and many knotty places had split radially like the cuts in a pie. After trying several different ways to make a presentable job of repainting the building at the lowest possible cost, I finally solved the problem by adding whiting to a good grade of house paint. The paint was mixed thick enough so that it would not run out of the cracks, but not too thick to adhere well to the rough surface.—MAURICE GORE.

Furniture Casters Need Oiling to Prevent Corrosion

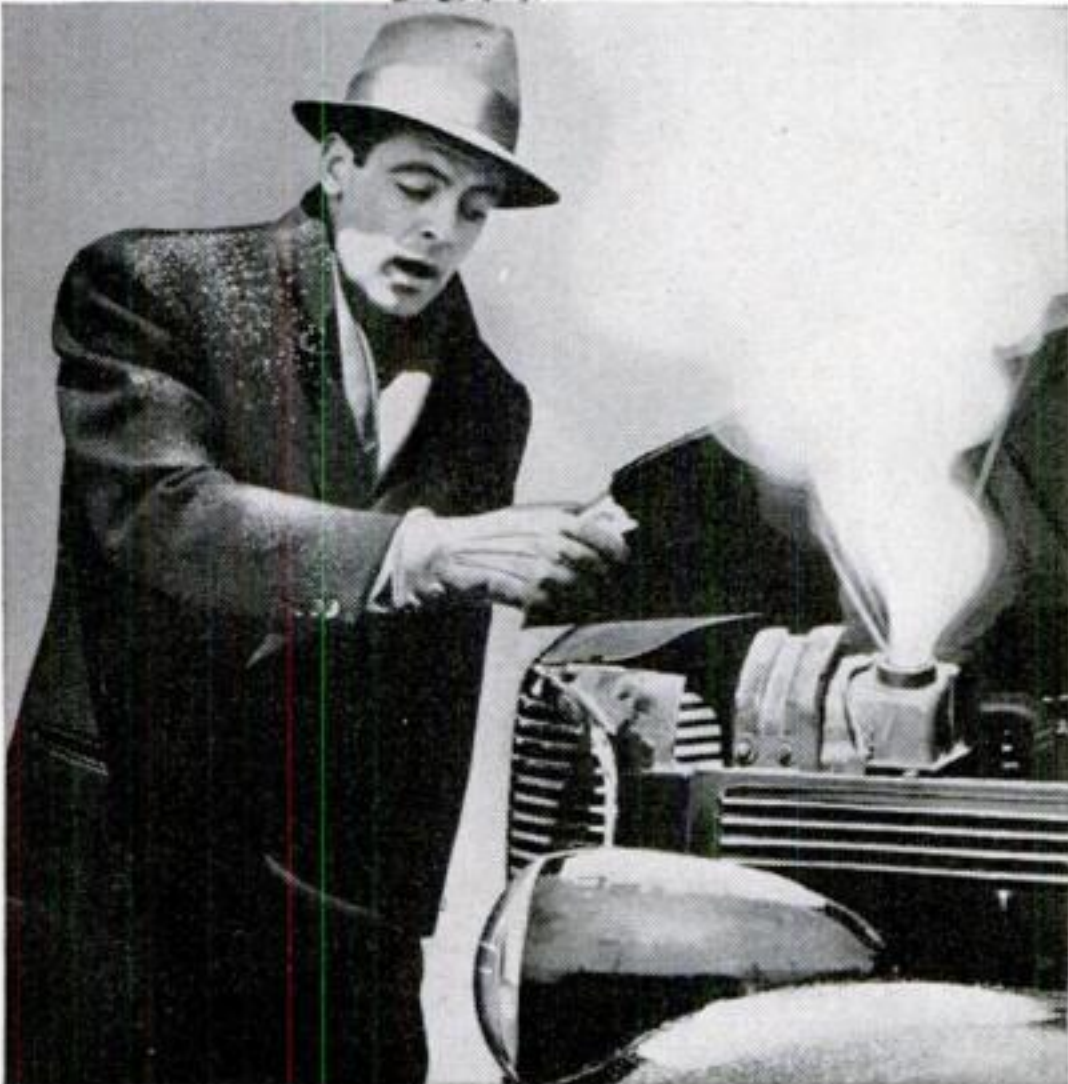
IF THEY are neglected for years, casters on beds and other heavy pieces of furniture may become so corroded and stiff that they will neither swivel nor roll, and the floor then becomes badly marked up. To avoid this, take out the casters occasionally and put a little heavy oil or petrolatum on the spindle or bearings and on the pinion of the roller.—H. W. MATTHAES.

Checking Cracks in Plate Glass

WHEN a plate glass window becomes cracked, but not so badly that it has to be replaced, it is desirable to take some steps to prevent the crack from extending. One way to do this is to score an arc about $\frac{3}{4}$ " in diameter with a glass cutter at a point $\frac{1}{4}$ " or $\frac{3}{8}$ " beyond the end of the crack. The mark is made in such a way as partly to inclose the end of the crack, but it must not touch it. When the crack later extends to the arc, it runs into it and is stopped.



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Camera Shoulder Strap Kept from Slipping

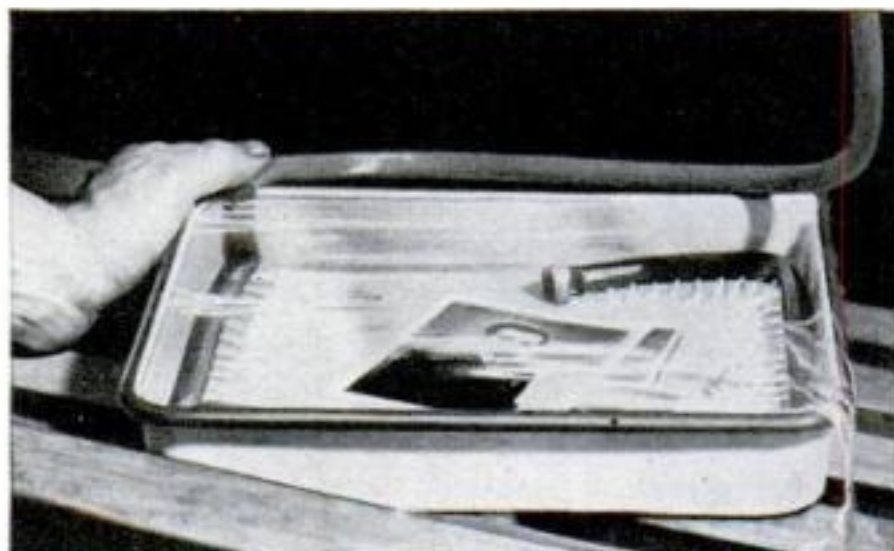
THE shoulder strap of an ever-ready camera case has a tendency to slip off. To give it a positive grip on your shoulder, cut a strip about 2" by 8" from a rubber stair pad or discarded inner tube. Make a pair of slits at each end and thread the strap through them as illustrated.—RAY KERSCHNER.



A rubber shoulder piece is added to the strap

Brass Wire Stiffens Tube for Print Washer

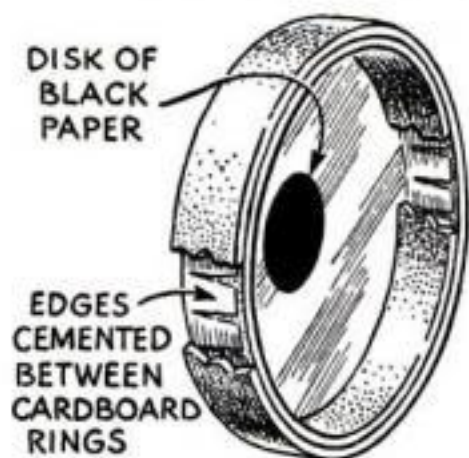
WHEN prints are washed in an ordinary tray with the aid of a rubber hose, it is an improvement to insert a piece of brass or other nonrusting wire in the tubing so that it can be bent as shown below to fit around the bottom of the tray. Very small holes are cut at intervals in that part of the tubing which will rest in the tray, and the open end is doubled back on itself and bound with a piece of strong cord or brass wire. If the holes are small enough, the water will spray forcefully out of them and keep the prints agitated.—FRANK CAPORAE.



The tubing is kept in shape within the tray by a piece of stiff brass or other nonrusting wire



Lens Partly Covered to Get Soft-Focus Pictures



The spot is mounted on transparent tissue held between cardboard rings

WHEN high-speed camera lenses are stopped down considerably, the image becomes sharper because the center of the lens is generally freer from optical faults than are the edges. By using this principle in reverse — blocking off the center of the lens, and using

only the edges—beautiful soft-focus effects may be obtained.

A device for achieving this can be made in a few minutes. Just cement a thin disk of black paper to the center of a clear, thin piece of transparent cellulose wrapping material. Clamp the edges between two strips of cardboard rolled into a sort of embroidery frame just large enough to fit the lens mount. The black disk should be held as close to the lens as possible, and must, of course, be smaller than the diaphragm opening used. By using disks of different sizes, various degrees of softness may be obtained. The increase in exposure necessary may be calculated by subtracting the area of the disk from the area of the camera aperture.

Oars for Model Lifeboats

AN ADDED touch of realism may be given to lifeboats and dories on ship models by lashing sets of oars across the thwarts. For very small models, the oars may be shaped from toothpicks. Lash them in place with cotton thread that has been dipped in strong tea to color it.—P. H. S.

Can You BRING BACK SUMMER IN November?



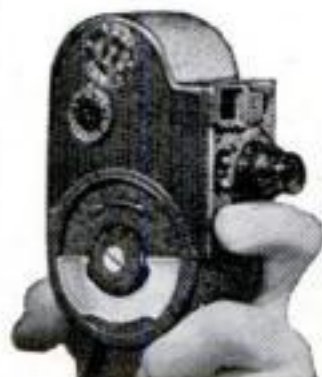
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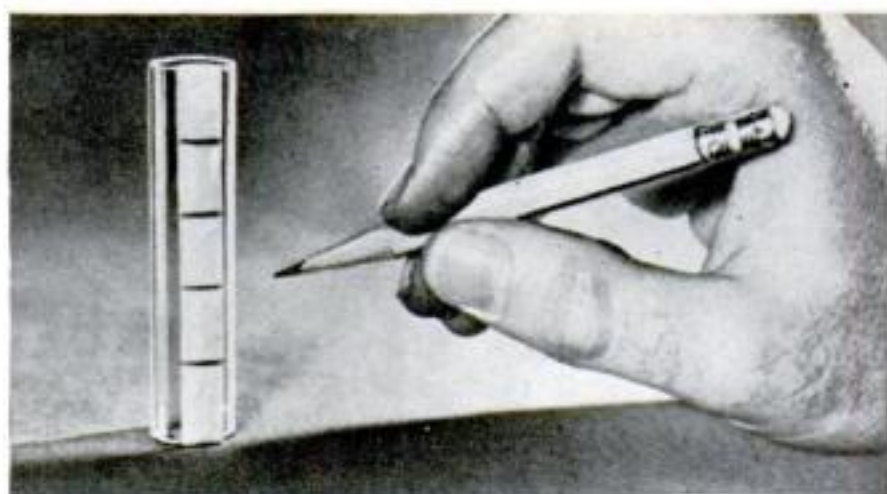


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• • •

VERY old negatives sometimes have large patches of yellow stain that cannot be removed by any sort of bleaching process. The best way out is to make a positive in the enlarger by using a G (yellow) filter on panchromatic film or plate. From this positive, which will be free from stain, make a new negative.—E. B. DENNISON.

Spring Clothespin Keeps Prints from Clogging Drain

WHEN a drain of the type illustrated is used over the outlet of a darkroom sink for washing prints, an ordinary spring wooden clothespin, applied as shown to the overflow tube, will keep prints from floating over and clogging the drain.—SIDNEY R. BAYNE.



The clothespin projects up from the sink outlet and prevents prints from floating over the drain

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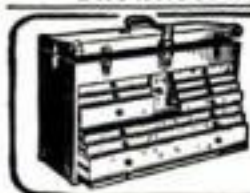
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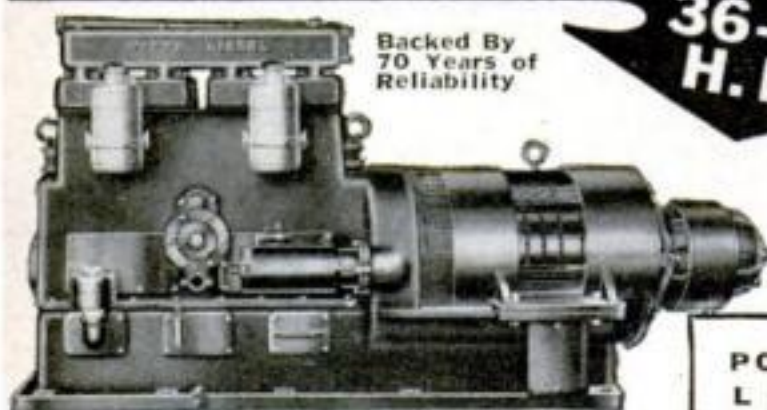
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Bombers or Battleships?

(Continued from page 56)

our Navy as engaging any enemy fleet far out on the high seas, where land-based planes play no part in the combat. It would be the carrier planes of the two fleets that would fight it out in the air, while the surface craft joined battle below. So far as carrier-based dive bombers or torpedo planes could shake off attackers, and damage opposing warships, so much would that contribute—even if not decisively—to the ultimate outcome of the engagement. But it would be joint action by sea and air that counted, whether it was an air bomb or a shell that finished off a hostile vessel.

So, from our own viewpoint, "air power" and "sea power" become merged into one. Taken separately, neither one completely assures our security. Reinforcing each other, they constitute a mighty defense team to safeguard America.

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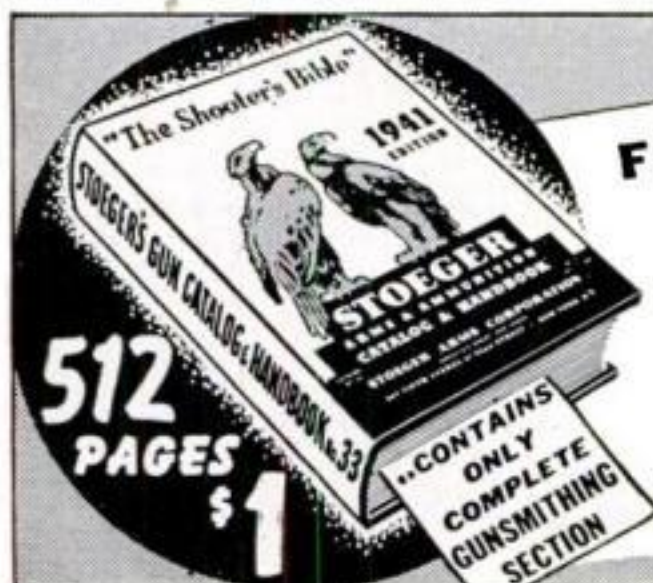
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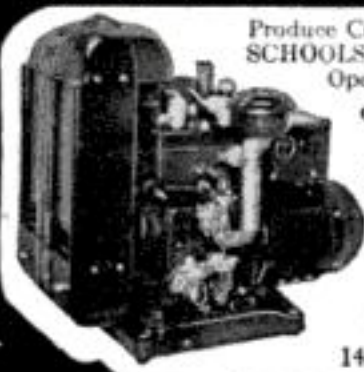
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More Guns for Our Army

(Continued from page 61)

at the rate of fifty-five or sixty miles an hour as long as it has a clear road. A long day's march for horse-drawn light artillery is thirty miles; truck-drawn light guns easily can do 175 miles a day. Horse-drawn artillery can keep up with foot-slogging doughboys and marching horse cavalry; truck-drawn guns can keep up with tanks and motorized infantry.

Field artillery isn't of much use without the auxiliaries which make it possible for it to fire accurately. The men at the guns seldom see what they are shooting at; their fire is directed by officers in observation posts connected with the batteries by telephone or radio, and often is corrected by observers in airplanes or balloons.

One of the most valuable artillery auxiliaries is the observation battalion. It's the most highbrow outfit in the Army. Its buck privates chat about asymptotes and its non-coms live on intimate terms with the binomial theorem. Its job is to locate the enemy's heavy guns by taking cross bearings on their flashes, and by measuring with scientific accuracy the travel from one microphone to another of the sound wave initiated when a gun is fired. The best results in sound ranging are obtained when fog or heavy rain blind visual observation.

We have one sound-and-flash observation battalion in our Army. The Germans have one with each of their divisions!

We also are short of airplanes especially designed for the spotting of artillery fire, and of the successful C-6 motorized observation balloon which, equipped with a detachable undercarriage with an airplane engine and propeller, can move from one place to another at a speed of fifty miles an hour.

But most vital is the Army's need for more guns with which to do its national-defense job. Official figures are not obtainable, but it is doubtful that we have more than one eighth the number we should have. Deciding on just how many guns, and just what sort of guns, the Army needs is the Army's job. Making sure that the Army gets those guns is the job of every American citizen!

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Seventeen-Year Locusts

(Continued from page 85)

Insects with similar habits, and even with "W's" on their wings, are known to appear in the Ural Mountains of Eastern Europe. Another mistaken belief which has been given wide currency is the idea that adult cicadas never take nourishment. It has been demonstrated that, in at least some cases, they insert sharp little beaks into plant tissues and drink sap. However, the damage caused by these insects is negligible.

Recently, scientists have begun a new line of cicada investigation, the study of their little-known activity below ground. At the University of Kansas, Dr. Raymond H. Beamer is now raising cicadas in tubs of dirt in which goldenrod roots supply the needed sap. Out of such researches may come the discovery that even the so-called annual cicada, the familiar, noisy, green "dog-day harvest fly," may take more than one year to develop and that all cicadas are really periodic, each having its own cycle of years needed for its development.

In any case, the seventeen-year variety holds the record for the length of time required to reach maturity. The successive appearances of these insects form a sort of slow-motion insect clock, recording time in seventeen-year intervals. Only twenty-six times has this clock completed a revolution since Christopher Columbus discovered America. Only eighteen generations of the cicadas have appeared since the Pilgrims landed at Plymouth; only ten since the American Revolution; and only four since the Civil War. Although each brood of the seventeen-year cicada, in northern states—and the thirteen-year cicada, in southern states—requires its full period to develop, there are different broods so that every year, somewhere in America, periodic cicadas are appearing. The present widespread brood, Number XIV, is celebrated as the one first seen by white settlers.

As this is written, pale, antlike creatures are already hatching from the eggs laid in twigs by the female cicadas. They are dropping to the ground and disappearing from sight, beginning again the cycle which last commenced in 1923. Vast and sweeping changes—elections, wars, scientific advances—will occur during the years they will burrow through the darkness of the soil. Then, as though at a given signal, in the year 1957, they will tunnel upward to the surface. That emergence, seventeen summers hence, will complete once more the strange cycle of their astonishing existence.

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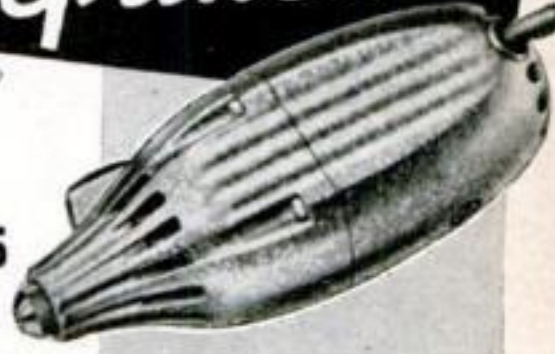
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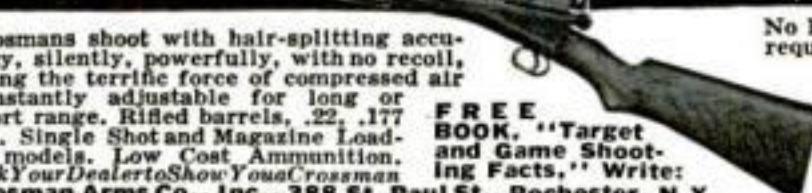
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There are many ways to reduce manufacturing costs. For example, a milling-machine hand had seven minutes to waste for every piece being automatically machined, so a small drill press was installed nearby to keep him busy. It proved profitable to both employee and employer.

A new kind of paste makes prussian blue seem an antiquated product for testing scraped, ground, or lapped surfaces with master gauges.

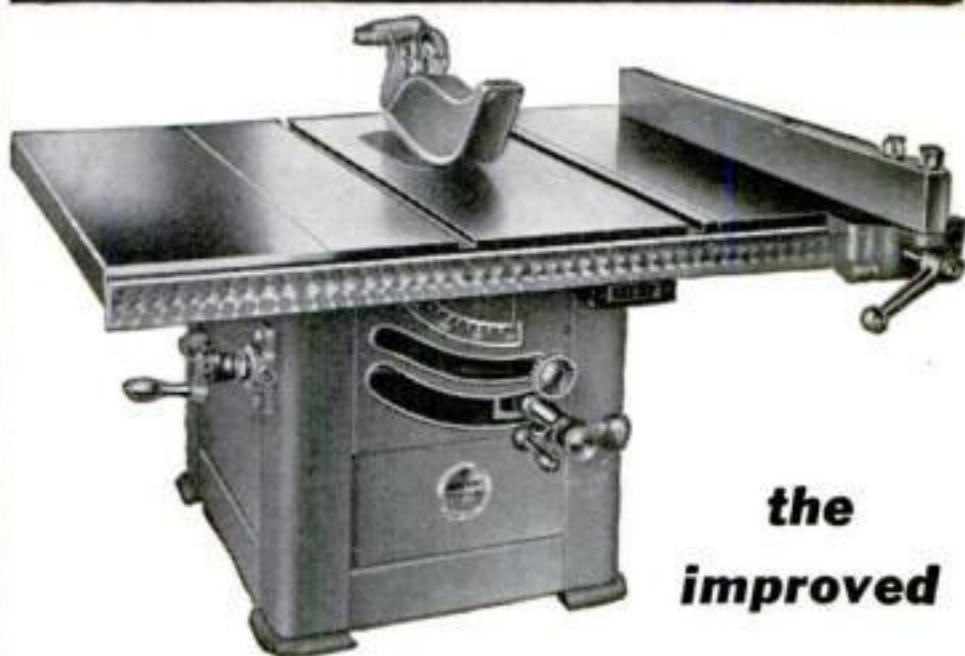
A manufacturer of a certain machine gun is reported to have said that 101 lb. of raw materials are required to produce 18 lb. of finished parts. From a 1940 manufacturing point of view, something appears to be decidedly wrong.

A tool-post grinder often proves useful in connection with a shaper, but I recently discovered that an electric drill doesn't take a back seat in this respect either. If you use your ingenuity, you can devise several means to brace it on the tool-post slide.

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Waterproof Glue Mixed in Developer Cans

A DOUBLE can of the type in which photographic developers are sold is a handy small container for powdered waterproof (case-in) glue. The inner can may be used as a mixing pot for the glue, and the large can is of sufficient size to hold a surplus amount of the dry glue for use at some future time.



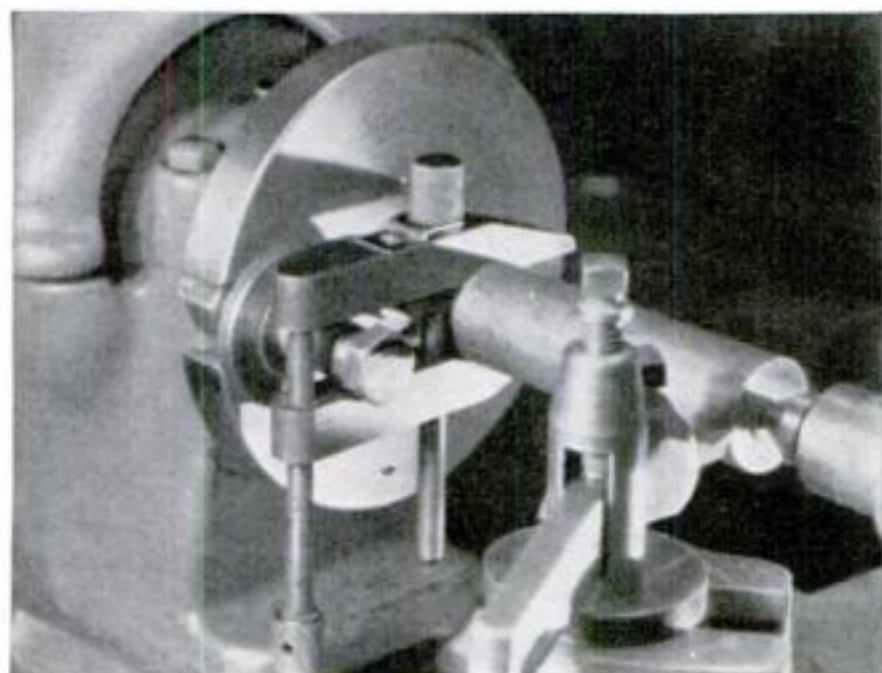
The glue powder and water are mixed in the inner can. Surplus dry glue is kept in the large can

Detecting Thin Internal Cuts

It's a trick from the old school, but you can detect audibly the removal of even 0.0005" stock while threading internally. Attach fine music wire to the external surface of the work, connect the other end to a small cylindrical cardboard box, and use it as an ear phone.—H. J. C.

Toolmaker's Clamp Acts as Small Lathe Dog

AN ORDINARY toolmaker's clamp can be made to serve as a lathe dog by fastening a bolt in the faceplate of the lathe to drive it, as illustrated.—C. W. W.



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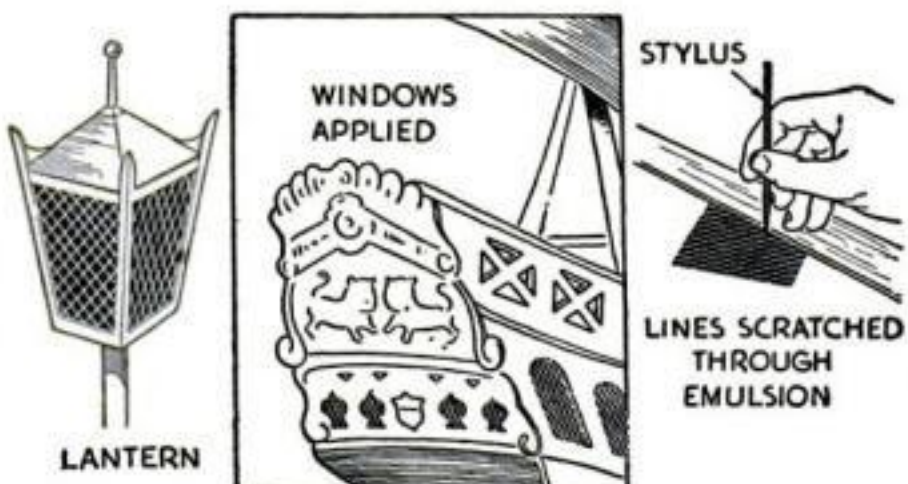
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LANTERN

The emulsion is scratched with a stylus and then coated with paint. The glossy side faces outward

Gaskets Cut Up into Washers

SOFT washers of various sizes can be cut from old auto cylinder-head or oil-pan gaskets. They will not mar highly polished surfaces when the nuts are tightened, and they can also be used as light-duty lock washers because of the slight resiliency of the inner layer of material.—W. C. W.

Cellulose Tape Fastens Notebook Index

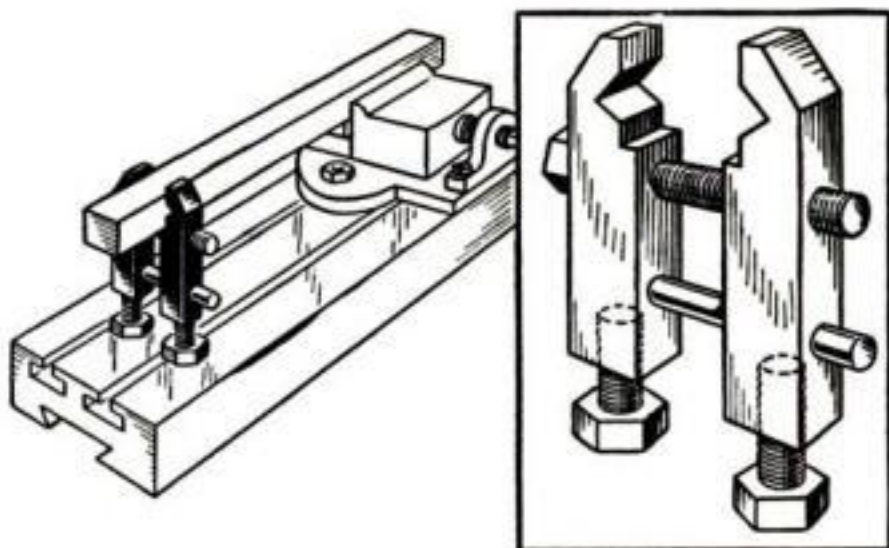
SMALL pocket notebooks and other books may be indexed by placing the typewritten index letter, phrase, or number between a fold of transparent cellulose adhesive tape as shown below.—R. O. L.



This One



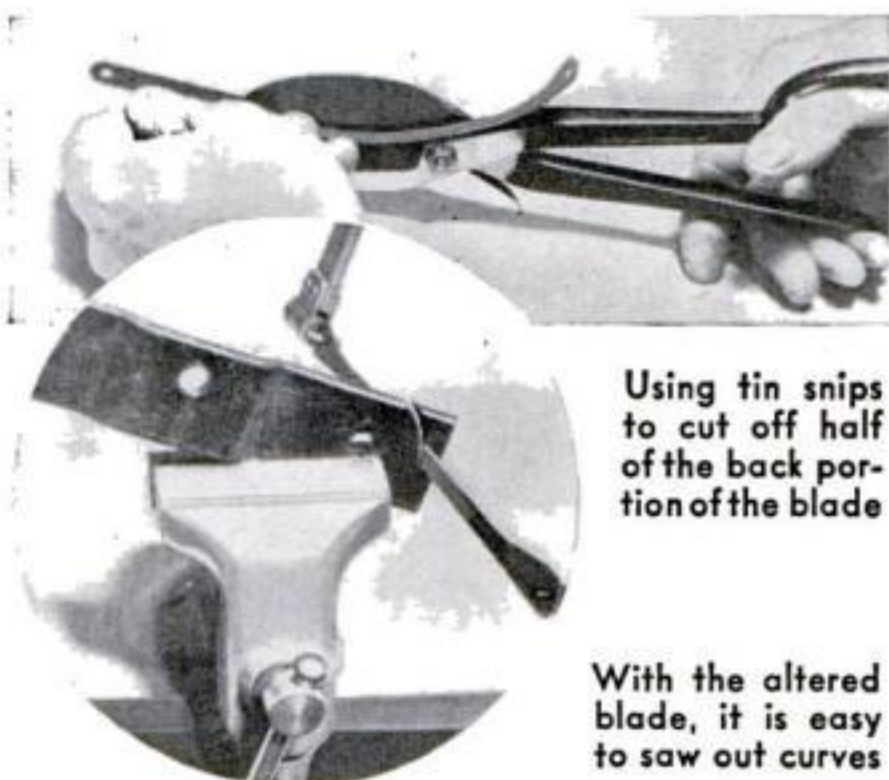
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TOOLMAKERS and machinists who do much miller, shaper, and planer work will find parallel clamps of the type illustrated are a great aid in supporting flat, square, or round work. The jaws have a combination V-groove and step, and the heels are tapped for jack screws for leveling. The screws themselves can be short, because blocking can be used under them whenever the job requires it.—CHARLES H. WILLEY.

Hack-Saw Blade Narrowed for Cutting Curves



Using tin snips to cut off half of the back portion of the blade

With the altered blade, it is easy to saw out curves

WITH an ordinary hack-saw blade it is practically impossible to cut curves. This can be done, however, by cutting off about half of the back portion of a flexible-back blade with tin snips as shown. It is wise to test the blade at the back edge before attempting to cut, as some varieties may be too brittle. If the blade can be bent with pliers, it may be cut. A blade so altered can be used to cut fairly small curves, as shown above.—BENEDICT BRONSON.

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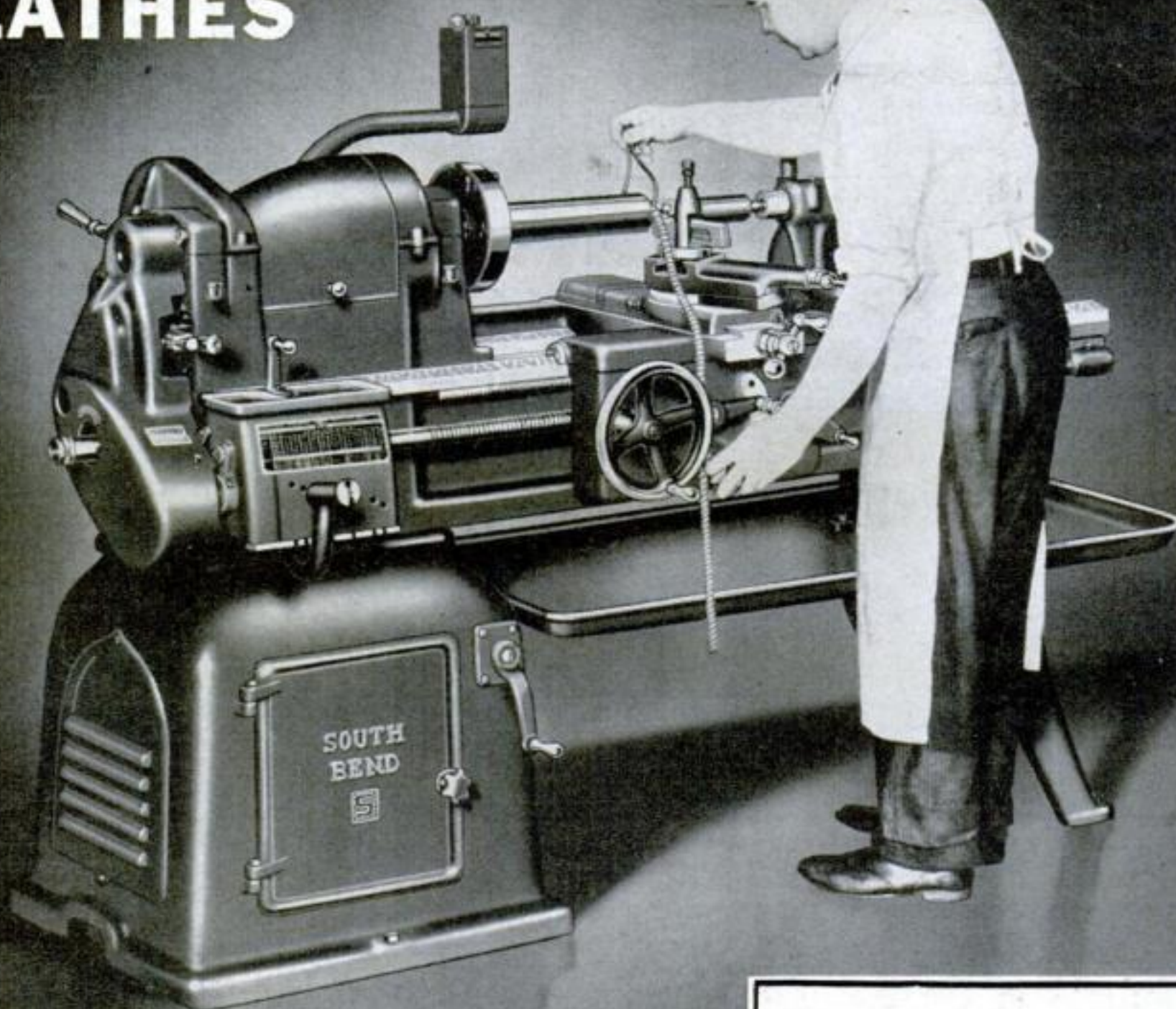
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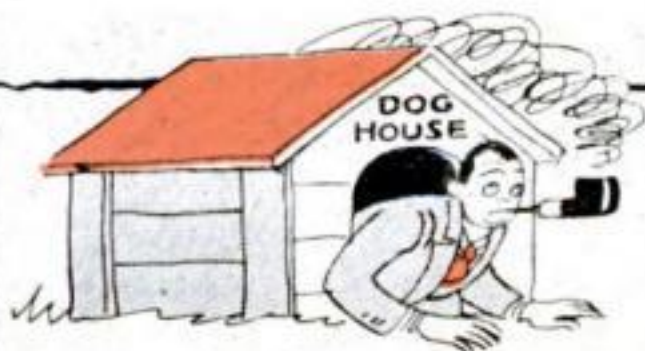
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